JOHN F. KENNEDY SPACE CENTER

TM-431-TWA

TECHNICAL MANUAL

BASE SUPPORT SERVICES CONTRACTOR

BASE UTILITIES OPERATION AND MAINTENANCE

VOLUME 5 OF 6 VOLUMES

APRIL 1, 1966

GPO PRICE $ _____

CFSTI PRICE(S) $ _____

Hard copy (HC) 3.00

Microfiche (MF) 1.30

ff 653 July 65

KSC FORM 16-12 (1/64)

NOTICE

1. This volume is one of six volumes describing the functional responsibilities of the Base Support Services Contractor.

2. The six volumes comprising this series are as follows:

   Vol. 1 ADMINISTRATION OF THE MAINTENANCE AND OPERATIONS PROGRAM
   Vol. 2 PREVENTIVE MAINTENANCE
   Vol. 3 ROADS AND GROUNDS
   Vol. 4 HEAVY EQUIPMENT
   Vol. 5 BASE UTILITIES
   Vol. 6 SHOPS, FIELD ENGINEERING, AND AREA SERVICES

3. Additional copies of these manuals are available upon written request to the Assistant Manager, Maintenance Engineering, TWA-651.

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VOLUME 5

BASE UTILITIES OPERATION AND MAINTENANCE

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SECTION I
HIGH VOLTAGE POWER DISTRIBUTION

1.1 PURPOSE

This procedure establishes the operating procedures for the high voltage (480 volts and higher) power distribution system of the Kennedy Space Center Industrial Area and defines the Base Operations Division (BOD) responsibility for operation and maintenance of high voltage electrical equipment at LC-39.

1.2 GENERAL

This procedure supplements the BOD/LSOD agreement, dated 10/30/64, and Launch Support Operations Division (LSOD) Power Systems Interface Guidelines for LC-39, dated 7/12/65.

1.2.1 OPERATIONAL INTERFACE. Operational interface is the extent of BOD responsibility for operation of switchgear, controls, and similar devices.

1.2.2 MAINTENANCE INTERFACE. Maintenance interface is the extent of BOD responsibility for maintenance of lines and equipment.

1.3 RESPONSIBILITIES

1.3.1 INTERFACE. LSOD shall have the responsibility on the line side of any interface. The BOD shall have the responsibility on the load side of any interface.

1.3.2 DETERMINATION. LSOD shall retain full responsibility for all maintenance and operation except for specific BOD responsibility as defined in this section. Fringe areas shall be LSOD responsibility until clarified by a revision to this section.

1.3.3 OPERATIONAL ACCESS. BOD shall have access to and operational responsibility for switchgear and devices which are part of the control system for the BOD assigned load devices, as well as for all components of the connected load.

1.3.4 MAINTENANCE ACCESS. BOD or the user shall have maintenance access to and responsibility for BOD assigned load devices, load controllers, and/or control stations, except where controllers and/or control stations are within the enclosure of a motor control center or other unitized distribution

center. BOD shall have maintenace access to and responsibility for control and power cables serving the connected loads and the controller, except where such cables originate at a unitized distribution center. BOD shall make requests from the Contractor Power Section of LSOD for access to motor control centers and/or other unitized distribution centers, when testing or trouble shooting is necessary.

1.3.5 ADDITIONS AND MODIFICATIONS. The user shall initiate requests for additions and modifications on Base Support Services Work Order Authorization, KSC Form 26-1. These forms shall be used in accordance with current NASA instructions. The Contractor Power Section of LSOD shall accomplish the additions and modifications, when an approved work order is issued.

1.3.6 TROUBLE CALLS. Correction of any disorders which may develop within the high voltage systems is a responsibility of LSOD per item 36 of BOD/LSOD agreement, dated 10/30/64. Trouble calls pertaining to high voltage systems shall be directed to the contractor primary substation operator of LSOD.

1.4 PROCEDURE.

1.4.1 OPERATION. The primary substation will be operated in accordance with "Operating Instructions, Electric Substation M6-996", included as an attachment to this section.

1.4.2 SWITCHING. The switching operations accomplished outside the primary substation shall be by written order only, and these orders shall be prepared by the superintendent in charge of the substation. Verbal switching orders shall not be issued nor accepted.

Each written switching order shall be issued to and carried out by high voltage system journeymen. Each step in remote switching will be reported to and coordinated with the substation operator by telephone or radio and will include arrival at and departure from the remote switching location.

1.4.2.1 Emergency Work Orders. The assistant superintendent, Electrical Utilities, or his designated representative, may issue switching orders for the protection and safety of equipment and personnel, for preserving continuity of service, or for restoring service after an outage caused by a cable fault, equipment failure, lightning, or other emergency. However, all such operations shall be reported with a detailed explanation in writing to the Chief, Electrical Utilities (NASA). This written report shall be made within 24 hours following the incident.

1.4.2.2 Routine Work Orders. Persons or organizations having a requirement for power interruption or other switching operations shall submit a written request on KSC Form 26-67 NS at least three working days prior to the planned operation.

1.4.2.3 Work Order Approval. All requests must be approved by the assistant superintendent , Electrical Utilities, and concurred with by the Chief, Electrical Utilities (NASA), to effect a work order.

1.4.2.4 Work Order Completion. The work order shall be marked with the date and time of departure, return, operation, and any additional information obtained during execution of the order.

1.4.3 MAINTENANCE. Maintenance of the system equipment and structures will be accomplished in accordance with Preventive Maintenance Instructions (PMI), as issued by the Work Control Section.

1.4.3.1 Work Orders. Work order requests for switching to permit preventive maintenance shall be processed as described in paragraph 1.4.2 preceding.

1.4.3.2 Switching. The switching requested shall include restoration of normal service, upon completion of the work. Outage shall be kept to a minimum and, whenever practical, planned so as to provide continuity of service during the maintenance period.

1.5 ATTACHMENTS

"Operating Instructions - Electric Substation M6-996" forms a part of this procedure and is included as an attachment.

ATTACHMENT

OPERATING INSTRUCTIONS

ELECTRIC SUBSTATION

M6-996

Prepared by

Production Engineering

November 18, 1965

PLACING IN SERVICE

TRANSFORMER NO. 1 OR NO. 2

Both transformers in standby condition and Instrumentation transformer OCBs open.

To place one transformer in service.

Step		
	AT TRANSFORMER	
1	Paralleling switch	Individual
2	Control switch	Auto
	AT CONTROL PANEL	
3	Tap change switch	Manual
4	Tap position	Center
5	Tap change switch	Auto
6	Transformer OCB	Close

REMOVING TRANSFORMERS NO. 1 OR NO. 2 FROM PARALLEL LOAD

Assume both transformers in parallel load.

To remove transformer No. 2 load.

Step	AT CONTROL PANEL	No. 1	No. 2
1	Tap change switch	Auto	Auto
2	Transformer OCB	-	Trip
	AT TRANSFORMER		
3	Control switch	Auto	-
4	Paralleling switch	Individual	-

PLACING TRANSFORMER NO. 3 OR NO. 4

IN SERVICE

Assume both transformers in standby condition and Industrial Transformer OCBs open.

To place one transformer in service.

Step	AT TRANSFORMER	
1	Local-Remote Switch	Remote
2	On-Off Paralleling Switch	Off
3	*Ind., Par. Fol., Par. Mas switch	Ind.
	AT CONTROL PANEL	
4	Tap change selector switch	Auto
5	Transformer OCB	Close

*Abbreviations as marked on escutcheon mean: Individual, Parallel Follow, Parallel Master.

PARALLELING

TRANSFORMERS NO. 1 AND NO. 2

Assume Transformer No. 1 in service.

To parallel transformer No. 2 with No. 1.

Step	AT TRANSFORMER	No. 1	No. 2
1	Paralleling switch	-	Parallel
2	Control switch	-	Remote
3	Paralleling switch	Parallel	-
4	Control switch	Remote	-
	AT CONTROL PANEL		
5	Tap change switch	Auto	Off
6	Tap position	-	To match
7	OCB	-	Close
8	Tap change switch	-	Auto

PARALLELING

TRANSFORMERS NO. 3 AND NO. 4

Assume transformer No. 3 in service.

To parallel transformer No. 4 with transformer No. 3.

Step	AT TRANSFORMERS	No. 3	No. 4
1	Local - remote switch	Remote	Remote
2	On-off paralleling switch	Off	Off
3	*Ind.,Par. Fol.,Par.Mas.Switch	Ind.	Ind.
	AT CONTROL PANEL		
4	Tap change selector switch	Auto	Manual
5	Tap position	-	To match
6	Transformer OCB	-	Close
7	Tap change selector switch	-	Auto
	AT TRANSFORMERS		
8	*Ind.,Par. Fol.,Par. Mas. switch	Master	Follower
9	On-off paralleling switch	On	On

*Abbreviations as marked on escutcheon mean: Individual, Parallel Follow, Parallel Master.

REMOVING TRANSFORMER NO. 3 OR NO. 4 FROM PARALLEL LOAD

Assume transformers in parallel and combined load within the rating of one transformer.

To remove transformer No. 4 from service.

Step	AT CONTROL PANEL	No. 3	No. 4
1	Tap selector switch	Man.	-
	AT CONTROL PANEL		
2	Transformer OCB	-	Trip
	AT TRANSFORMERS		
3	On-off paralleling switch	Off.	Off
4	*Ind., Par. Fol.,Par. Mas. switch	Ind.	Ind.
5	Tap selector switch	Auto	-

*Abbreviations as marked on escutcheon mean: Individual, Parallel Follow Parallel Master.

TO DEENERGIZE ANY TRANSFORMER AND ITS OCB

Assume any transformer is in standby condition (transformer OCB. open) to completely deenergize both transformer and its OCB:

Step

1 Verify that OCB is open
2 Open manual 13.8, KV disconnects at OCB
3 Open Motor operated 69 KV disconnect
4 Remove M.O.D. fuses
5 Remove M.O.D. drive shaft pin and deliver to shift man in charge
6 Close 69 KV grounding switch

Note: There is no disconnect between OCB and transformer. Safety demands all of the above operations be performed before working on or near high voltage parts of either a transformer or its OCB.

OPERATION

TO DEENERGIZE FEEDER OCB

Assume all feeder OCB's in service; to remove one feeder OCB (No. 211 for example) from service for maintenance.

To accomplish this removal, the circuit served by the OCB to be removed from service must be transferred to an underloaded feeder OCB to preserve continuity of service.

Step

1 Assume feeder No. 207 underloaded.
2 Close disconnects between feeder No. 207 pothead and transfer bus.
3 Close disconnects between feeder No. 211 and transfer bus.
4 Trip OCB on feeder No. 211, open disconnects on both sides of OCB.

TO RESTORE FEEDER NO. 211 OCB TO SERVICE:

5 Close disconnects on both sides of OCB No. 211.
6 Close OCB No. 211
7 Open disconnects between transfer bus and feeder No. 211.
8 Open disconnects between transfer bus and feeder No. 207.

SECTION II
EMERGENCY AND STANDBY POWER GENERATION

2.1 PURPOSE

To outline the steps necessary for providing sufficient emergency and standby power to various KSC locations where loss of routine power is due to:

1. Planned preventive maintenance
2. Hurricanes or other acts of God
3. Prolonged interruptions of normal power

2.2 GENERAL

The starting and operation of emergency generators (permanently installed) is either by an automatic switch or by a manually operated double-throw switch with push-button starting capabilities. Buildings having permanently installed emergency generators are:

1. M6-493 (manual) M3-3
2. M6-342
3. Q6-82
4. M7-504
5. M7-505
6. M7-355
7. M6-791
8. J6-393

The function of the standby generators is to provide a limited supply of power to the emergency circuits in the critical areas of the building involved.

Additional power for prolonged outages will be covered in Section VIII of Volume 6, Portable Power Generation. The operation and maintenance of the emergency power facilities in the Industrial Area is a Base Operations Division (BOD) responsibility and will be accomplished by the Base Support Services Contractor (Heavy Equipment Group of Base Utilities).

In the Launch Complex 39 area, the emergency power facilities are a Launch Support Operations Division (LSOD) responsibility by agreement with BOD. The Emergency Power Manual issued by BOD includes a procedure for connecting and operating the portable emergency generators. The Heavy Equipment Group is to follow this procedure.

2.3 PROCEDURE

The following steps outline the method of initiating emergency and standby power generation:

a. The responsible KSC agency (LSOD for LC-39; BOD for the Industrial Area) shall make the necessary arrangements with NASA (in accordance with the Production Control Procedure) and all affected contractors and shall notify them of the impending power interruption. This written notification should be submitted at least 1 week in advance and should request a written acknowledgment.

b. The responsible KSC agency shall test-run the standby generators and report the written results of the test to the appropriate NASA technical representative.

c. The responsible KSC agency shall inspect the emergency standby generator, check the fuel supply, and prepare for operation.

d. At the designated time for the "power outage," the changeover operation shall be accomplished by eliminating the normal source of power. This step will test the automatic switchover and start the standby generator (except in the case of manually-operated generators). Necessary switching shall be made by the responsible KSC agency. (Refer to Section I of this volume: High Voltage Power Distribution.)

e. The standby generators shall pick up the designated critical power circuits which are connected to the emergency system.

f. The necessary generators required for additional power may then be connected and started, following the steps outlined in the procedure of Section VIII of Volume 6 (Portable Power Generation).

g. The responsible agency operating the generators shall maintain and control the voltage and load conditions.

h. Upon completion of the planned maintenance work, notification shall be given to all the affected agencies.

i. The generators supplying the additional power shall then be "off loaded" and shut down in accordance with the procedure for that function. The cables will then be disconnected from the building equipment.

j. Power shall then be restored to its normal source; after the automatic transfer switch has been operated (returning to the "normal" position), the emergency generator shall be stopped.

k. The responsible agency shall inspect the emergency generator and note any undue wear or deficiencies and submit a written report on the condition of the unit.

VOLUME 5

SECTION III

WATER DISTRIBUTION SYSTEM

NOTE

Information for this section was not available for publication at this time. When this section is available, copies will be forwarded to recipients of this manual.

VOLUME 5

SECTION IV

FIRE PROTECTION SYSTEM

NOTE

Information for this section was not available for publication at this time. When this section is available, copies will be forwarded to recipients of this manual.

SECTION V
WATER TREATMENT SYSTEMS (CLOSED SYSTEMS)

5.1 PURPOSE

This procedure establishes requirements for treatment of water used in the air-conditioning system cooling tower.

5.2 GENERAL

The main water treatment system is composed of three subsystems; the water treatment system, water filtration system, and water softener system. The water treatment and filtration systems will be combined and then described. The water softener system will be individually described in paragraph 5.4.

5.3 WATER TREATMENT AND FILTRATION SYSTEMS DESCRIPTION - BUILDING K6-994.

Initially, makeup water is supplied through an 8-inch pipeline from the water softener system and is then treated with sulphuric acid, algaecide, and zinc chromate. A portion of the treated water flows through filters to blend with the air-conditioner condenser water to the cooling tower. This treatment inhibits formation of algae, corrosion slime, and scale. The system includes chemical feed equipment, regulators, storage tanks, valves, piping, filters, and recorders to control chemical mixtures and flow. (See locator diagrams Figure 5.1)

5.3.1 SYSTEM OPERATION. The chemical feeder injects the required mixture of sulphuric acid and zinc chromate. The V-notch chlorinator injects the needed chlorine gas. A flow transmitter receives signals of water flow and regulates the flow in direct proportion to the flow of soft water to the cooling tower. A pH cell emits an electrical signal to the dynalog computer/recorder, which develops a pneumatic signal that is directed to the sulphuric acid feed pump stroke positioner. Any zinc chromate feed variation, other than a result of soft water flow, must be manually initiated at the pump by setting the stroke positioner hand crank. The chlorine feeder ejects chlorine gas from the liquid chlorine tanks into a secondary makeup water supply to the cooling tower. The mixture initially occurs in the chlorine ejector and is then piped to the cooling tower where it acts as a deterrent to slime and algae formation. The chlorine recorder records the amount of chlorine flow, and a timer initiates the ejection periods at predetermined intervals. A portion of treated water flows from the cooling tower through an 8-inch pipe to a splitter box. The water is filtered and strained before returning to the cooling tower. A backwash control senses an increase in suspended particles and activates a three-way solenoid valve, and the suspended particles are flushed into a drain while water flow is transferred to another filter.

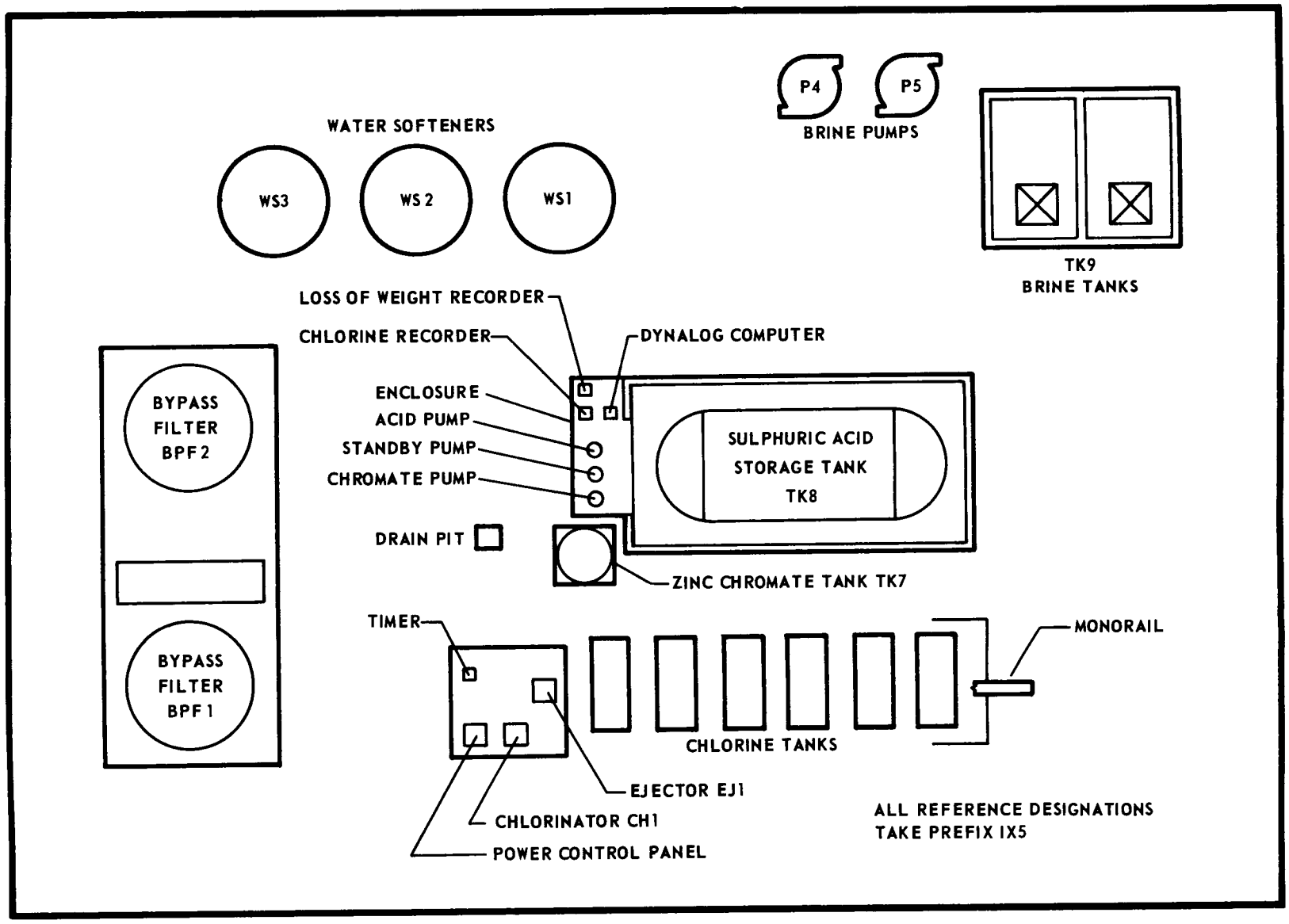


Figure 5-1. Water Treatment System Location Diagram

5.3.2 OPERATIONAL RESPONSIBILITY. The operation of the water treatment system is the responsibility of the Base Support Services Contractor (BSSC) Base Utilities Group.

5.3.3 MAINTENANCE RESPONSIBILITY. The BSSC maintenance mechanics are responsible for performing preventive maintenance inspections and functions in accordance with Preventive Maintenance Instructions (PMI). Preventive maintenance engineers issue written maintenance instructions to mechanics. The preventive maintenance mechanics shall perform, on a scheduled basis, all necessary inspections and work tasks as issued by BSSC Production Control.

5.3.4 REFERENCED DOCUMENTS. The following documents form a part of the established requirements for the water treatment and filtration system:

1. Launch Complex 39 (LC-39) Drawings 201-100, Volume 31, Sheets 31 through 46

2. TM4-135-39 Water Treatment System, Volumes I and II

3. BSSC Utilities Maintenance Engineering Operating Instructions (located at work site)

5.3.5 PROCEDURE. All safety precautions must be observed in operation and/or maintenance by personnel, when dealing with active and toxic chemicals. When necessary, personnel will don protective clothing, masks, and gloves when repairing leaks or repairing lines. In cases of contamination, the area must be cleared of all unauthorized personnel to minimize hazards and personnel injury. Entries shall be made in equipment log books on each shift, showing utilization and performance of equipment.

5.3.6 NORMAL OPERATION AND INSPECTION. The following procedural steps are performed during normal system operation. Figures 5-1 and 5-2 and Table 5-1 may be referred to for purposes of component location and identification, and Table 5-2 provides specific information concerning significant system components.

a. Observe that flow recorder R4 is recording flow (0-312 gpm), wind chart drive motor, and change chart as required.

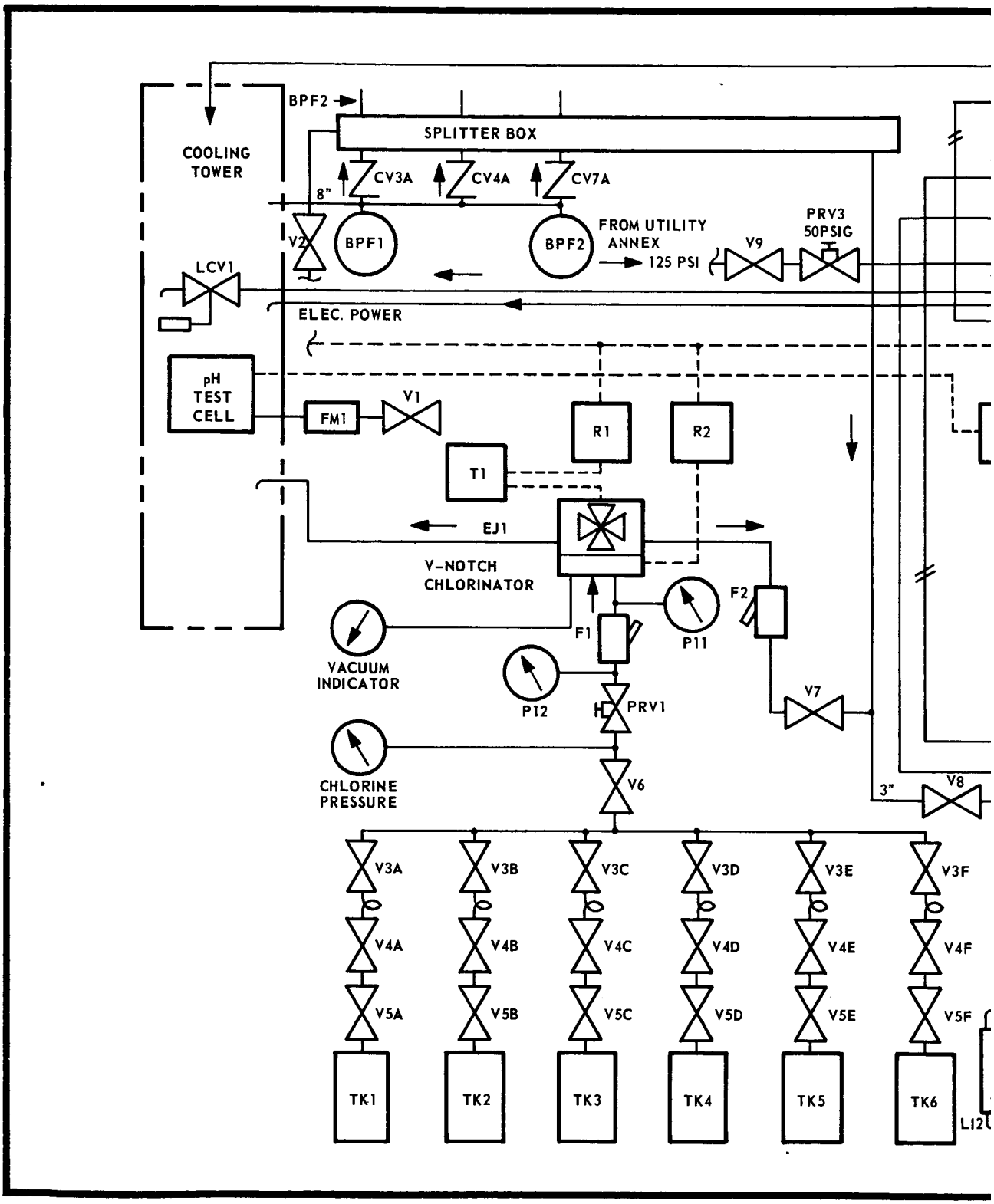
b. Observe that water meter WMI is indicating flow.

c. Observe that pressure indicator P13 shows 65 ± 5 psi.

d. Observe that pressure indicator P14 shows 40 ± 5 psi.

Table 5-1. Water Treatment System Coding

Code	Item Identification
BF	Butterfly Valve
C	Pneumatic Controller
CV	Check Valve
F	Filter
FM	Flowmeter
LI	Liquid Indicator
OR	Orifice
PRV	Pressure Reducing Valve
PI	Pressure Indicator
PDV	Pressure Differential Valve
PC	Pneumatic Computer
R	Recorder
RCV	Remote Control Valve
SOV	Solenoid Operated Valve
T	Timer
TK	Tank
TC	Test Cell
V	Valve
P	Pump


BPF2
SPLITTER BOX
COOLING TOWER
CV3A
CV4A
CV7A
8"
V2
BPF1
BPF2
FROM UTILITY ANNEX
125 PSI
V9
PRV3 50PSIG
LCV1
ELEC. POWER
pH TEST CELL
FM1
V1
R1
R2
T1
EJ1
V-NOTCH CHLORINATOR
F1
P11
F2
VACUUM INDICATOR
P12
PRV1
V7
CHLORINE PRESSURE
V6
3"
V8
V3A
V3B
V3C
V3D
V3E
V3F
V4A
V4B
V4C
V4D
V4E
V4F
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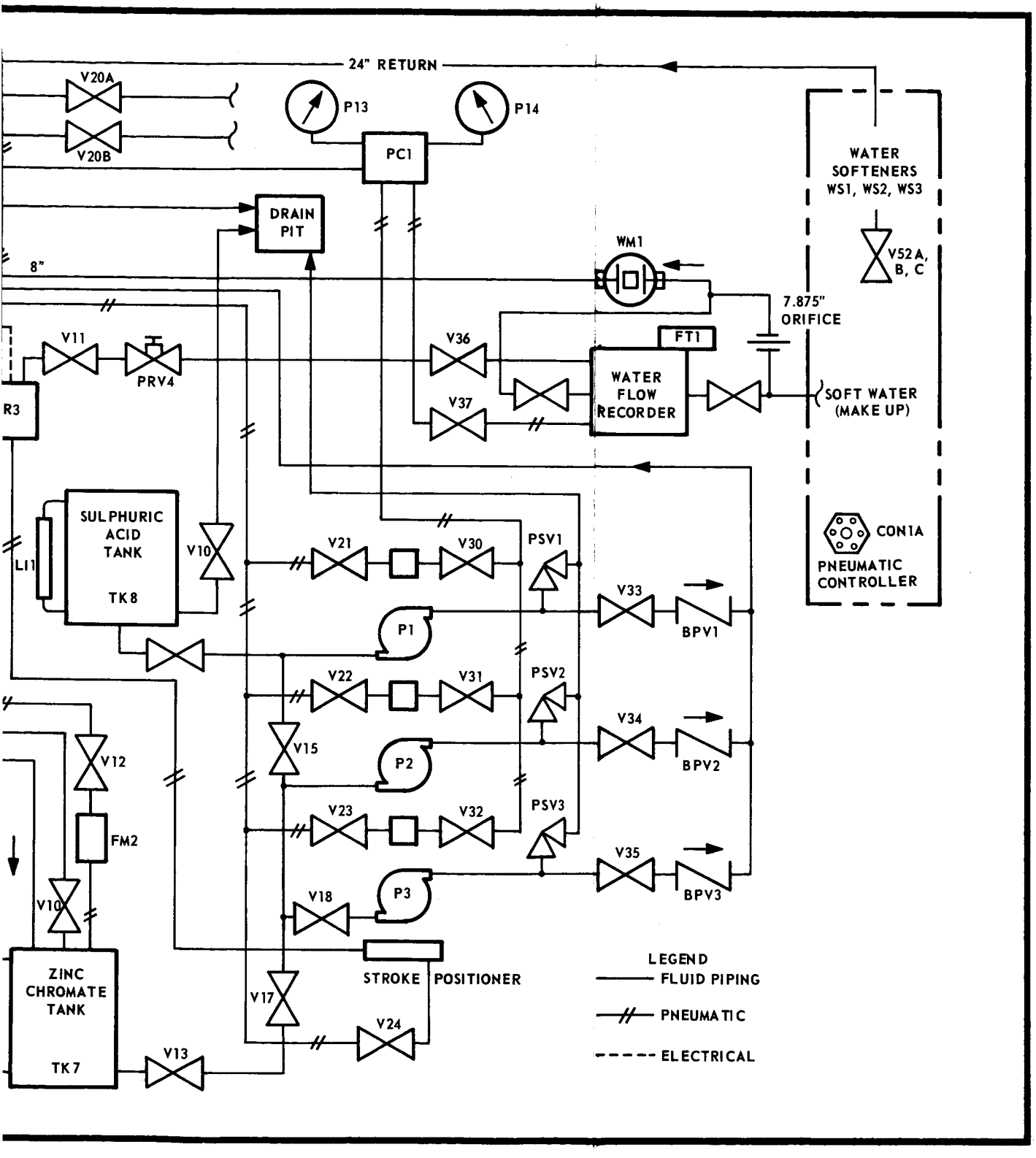


Figure 5-2. Water Treatment System Schematic Diagram

Table 5-2. Significant Water Treatment System Components

Component	Description
FLOWMETER FM3	
Type	Bypass, orifice sensing
Length (Approx)	10 in.
Width (Approx)	3 in.
Scale	0-300 gpm
Differential	400 in. water
SULPHURIC ACID TANK TK8	
Capacity	4500 gal
Diameter	7 ft (Approx)
Length	15 ft (Approx)
Air Dryer	Desiccant
Liquid Level Indicator LL12	
Type	Sight glass
Range	0-4500 gal
ZINC CHROMATE TANK TK7	
Capacity	104 gal
Liquid Level Indicator LL11	
Type	Pressure gage, differential sensing
Dial Size	5 in.
Range	0-200 gal

Table 5-2. Significant Water Treatment System Components (cont)

Component	Description
Flowmeter FM2	
Type	Glass tube, purge
Indicator	Floating ball
Control	Needle valve
CHEMICAL METERING PUMP(S) P1, P2, OR P3	
Pump	
Type	Positive displacement, reciprocating plunger
Stroke Speed (Max)	35 spm
Stroke Length	1/16 in. to 1-1/2 in.
Capacity (Max)	7.60 gph
Weight	Approx 25 lb
Variable Speed Drive	
Type	Pneumatically actuated, movable disc belt drive
Weight (Less Motor)	Approx 200 lb
Motor	
HP	1/2
RPM	1725
Voltage	120 volts, 1 phase, 60 cycles
Weight	Approx 35 lb

Table 5-2. Significant Water Treatment System Components (cont)

Component	Description
pH TEST FLOW CELL TC1	
Type	Inline process flow with sensing electrodes
Weight	10 lb
Sample Pressure	0-15 psig
Electrodes	
1. Self-Pressurized Process Reference Electrode	
2. Process Glass Electrode	
3. Process Thermo-Compensator	
DYNALOG COMPUTER/RECORDER R3	
Type	Recorder controller
Voltage	120 volts, 1 phase, 60 cycles
Control Air Pressure	15 psig
Weight	Approx 60 lb
Butterfly Valves BV1 thru BV3:	
Type	Air-actuated
Size	10 in.
Operating Pressure	50 psig (min)
Differential Line Pressure	10 psig

Table 5-2. Significant Water Treatment System Components (cont)

Component	Description
CHLORINE RECORDER R2	
Type	Electrically operated, time-chart recording, totalizer
Voltage	120 volts, 1 phase, 60 cycles
Operational Signal	10-12.5 vdc
LOSS OF WEIGHT RECORDER R1	
Type	Electrically driven, digital counter (5), reverse reading
Range	2000-0 lb
Voltage	120 volts, 1 phase, 60 cycles
Reset	Manual
TIMER T1	
Type	24 hr, electrical
Switch	
Type	Single pole, double throw
Rating	240 vac, 40 amp
Motor	
Speed	1 rpm/24 hr
Voltage	120 volts, 1 phase, 60 cycles

Table 5-2. Significant Water Treatment System Components (cont)

Component	Description
FLOW TRANSMITTER FT1	
Type	Mercury-filled range chamber, differential
Range	100 in.
Output	Mechanical linkage to recorder
Chart Drive	Mechanical 8-day motor
Mercury (Quantity):	
Range Chamber	13 lb
PNEUMATIC COMPUTER PC1	
Type	Squaring
Signals:	
Input	Square root, 3-15 psig
Output	Linear (input signal times itself)
BYPASS FILTER(S) BPF1 OR BPF2	
Type	Semiautomatic
Flow (Max , Per Unit)	435 gpm
Filter Compartments (Per Unit)	3
Diameter	15 ft
Height	9 ft
Strainers (Per Unit)	634

Table 5-2. Significant Water Treatment System Components (cont)

Component	Description
Solenoid Valves SOV1 thru SOV3	
Type	Electrical 4 way
Voltage	120 volts, 1 phase, 60 cycles
COOLING TOWER EQUIPMENT	
Level Control Valve LCV1	
Type	Angle-type, float controlled
Operation	Hydraulically operated diaphragm
Size	3 in.
Flowmeter FM1	
Type	Glass tube, float registering
Size:	
Pipe Size	1/2 in.
pH Cell Isolation Valve V1	
Type	Globe
Size	1 in.
WATER METER WM1	
Type	Propeller, registering
Range	100 million gal
Working Pressure	150 psig
Housing	Cast iron, flange connected

e. Observe that dynalog computer/recorder R3 shows 0-14 pH level, and change chart as required.

f. Observe that chlorine loss weight flow recorder R1 shows no less than 25 pounds.

g. Observe that pressure indicator PI 1 shows 25 $\pm$ 2 psi.

h. Observe that pressure indicator PI 2 shows indication between 0 and 100 psi.

i. Observe that chlorine pressure indicator shows 25 $\pm$ 2 psi.

j. Observe that chlorine vacuum indicator shows 12 inches (desired) water.

5.3.6.1 Emergency Shutdown. The following procedure shall be used to shutdown the water treatment system during an emergency. (See Figure 5-1 and 5-2.)

a. Place main line power panel circuit breaker in OFF position.

b. Close main chlorine supply valve V6.

c. Close sulphuric acid supply valves V16 and V18.

d. Close zinc chromate supply valves V15 and V17.

e. Close bypass filter supply valve V2.

f. Close water softener supply valves V52A, B, and C.

g. Close control air supply valve V9.

h. Manually position water softener controllers CON 1A, B, and C position indicators to SERVICE.

5.3.6.2 Normal Shutdown. (See Figures 5-1 and 5-2) Normal shutdown procedures are as follows:

a. Place pump circuit breakers P1, P2, and P3 in OFF position.

b. Place dynalog computer/recorder toggle switch R3 in OFF position.

c. Place chlorine recorder toggle switch R2 in OFF position.

d. Place power panel recorders circuit breakers in OFF position.

e. Close chlorine supply valve V6.

f. Close chlorine-feeder water supply valve V7.

g. Close dynalog computer/recorder air supply valve V11.

h. Close chemical metering pumps air supply valves V21, V22, V23, V24, V30, V31, and V32.

i. Close flow transmitter air supply valve V36.

j. Close zinc chromate tank (TK7) air supply valve V12.

k. Close zinc chromate supply valve V13.

l. Close sulphuric acid supply valve V18.

m. Close by-pass filters supply valve V2.

n. Place power panel by-pass filter circuit breaker in OFF position.

o. Close by-pass filter control air supply valves V20A and V20B.

5.3.6.3 Failure and Malfunction Measures for Uninterrupted Service. When equipment malfunctions or fails, the operating personnel will isolate the problem area and complete a temporary repair. To ensure uninterrupted service, maintenance personnel may assist operators when necessary. A permanent repair will be completed at the earliest possible date on the basis of scheduled equipment downtime. Operators will take necessary steps when power fails to ensure uninterrupted service. When standby electrical power is supplied, operators will ensure that proper phase rotation is established.

5.3.7 PREVENTIVE MAINTENANCE. Preventive maintenance procedures include periodic inspections, cleaning, adjustment, alignment, calibration, lubrication, and servicing of system and components.

5.3.8 STORAGE. Storage of chemicals, recorder charts, and any expendable items shall be based on a 30-day available supply for the water treatment plant. Material shall be readily available for daily control and pickup in the work area.

5.3.8.1 Spare Parts. Spare parts shall be stored in such places and manner that parts shall be readily available for immediate pickup when an emergency arises.

5.4 WATER SOFTENER SYSTEM DESCRIPTION - BUILDING K6-994

The water softener system consists of a brine tank and two pumps, an automatic brine meter and control, three zeolite water softener tanks and controls, and a raw water to soft water blending manifold. The treatment system is to provide a maximum water hardness of 100 PPM for all Vehicle Assembly Building (VAB) operational requirements for soft water. Test equipment is available to analyze the soft water and brine solution samples. Facilities are also provided for salt storage and handling.

5.4.1 SYSTEM OPERATION. Potable water enters the water softener system at a constant head pressure maintained by the elevated storage tank. Isolation valves permit a portion of the incoming raw water to enter the brine tank as makeup water for the salt-saturated brine solution. Another source of potable incoming water is supplied to a differential pressure operated blend valve and is metered at this point to mix with effluent zero soft water to maintain 100 PPM total effluent hardness. The system is interconnected with controls, valves,piping, and an alarm. In addition, brine induction is provided for regeneration of the water softeners.

5.4.2 OPERATIONAL RESPONSIBILITY. The operation of the water softener system is the responsibility of the Base Support Services Contractor (BSSC) Base Utilities Group.

5.4.3 MAINTENANCE RESPONSIBILITY. The BSSC maintenance mechanics are responsible for performing preventive maintenance inspections and maintenance functions in accordance with Preventive Maintenance Instructions (PMI) issued by the BSSC Preventive Maintenance Engineering Group. BSSC Production Control issues the preventive maintenance schedule for preformance of all preventive maintenance functions.

5.4.4 REFERENCED DOCUMENTS. The following documents form a part of the established requirements for the water softener system:

1. Launch Complex 39 (LC-39) Drawings 203-100, Volume 31, Sheets 31-36
2. TM4-135-39 Water Treatment System,Volumes I and II
3. BSSC Utilities Maintenance Engineering Operating Instructions (Located at work site)

5.4.5 PROCEDURE. All safety precautions shall be observed in operation and/or maintenance by personnel. Personnel will at all times observe the prescribed safety directives displayed in safety bulletins and shall follow safe practice standards. The foreman's safety instructions shall also be followed.

5.4.6 NORMAL OPERATION AND INSPECTION. The following procedural steps are preformed during normal system operation. (Figures 5-3 through 5-6 and Tables 5-3 and 5-4 may be referred to for purposes of component location and identification.)

a. Observe water softener WS1, WS2, and WS3 indicator lights for in service (green), ready for regeneration (red), and in generation (red) on status panel SP1.

b. Observe that water meter WM2 is indicating flow.

c. Observe that pressure indicator PI5 is indicating 50 $\pm$ 5 psi.

d. Observe that pressure indicator PI6 is indicating 46 $\pm$ 5 psi.

e. Obtain effluent sample at valve V51.

5.4.6.1 Emergency Shutdown. The following procedure shall be used to shut down the water softener system during an emergency:

a. Place power panel main line circuit breakers in OFF position.

b. Place power panel WATER SOFTENER circuit breakers in OFF position.

c. Close supply valve V52A, B, and C.

d. Close control air supply valve V61.

e. Place BRINE PUMP circuit breakers P4 and P5 in OFF position.

5.4.6.2 Failure and Malfunction Measures for Uninterrupted Service. When equipment malfunctions or fails, the operating personnel will isolate the problem area and complete a temporary repair. To ensure uninterrupted service, maintenance personnel may assist operators when necessary. A permanent repair will be completed at the earliest possible date on the basis of scheduled equipment down-time. If electrical power fails, operators will take necessary steps to ensure uninterrupted service when standby power is supplied. Operators will make certain that proper phase rotation is established during standby power operation.

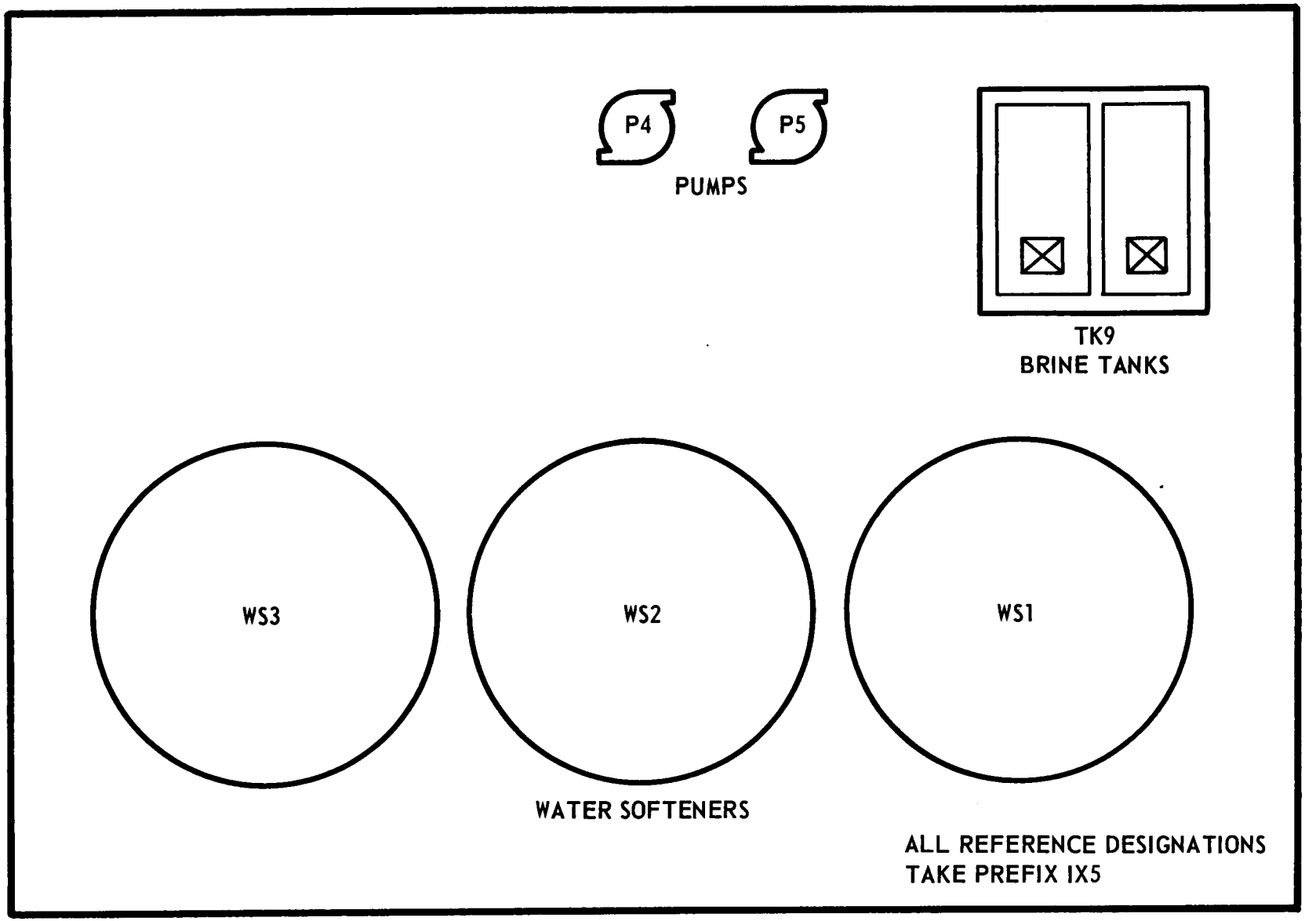


Figure 5-3. Water Softener System Locator Diagram

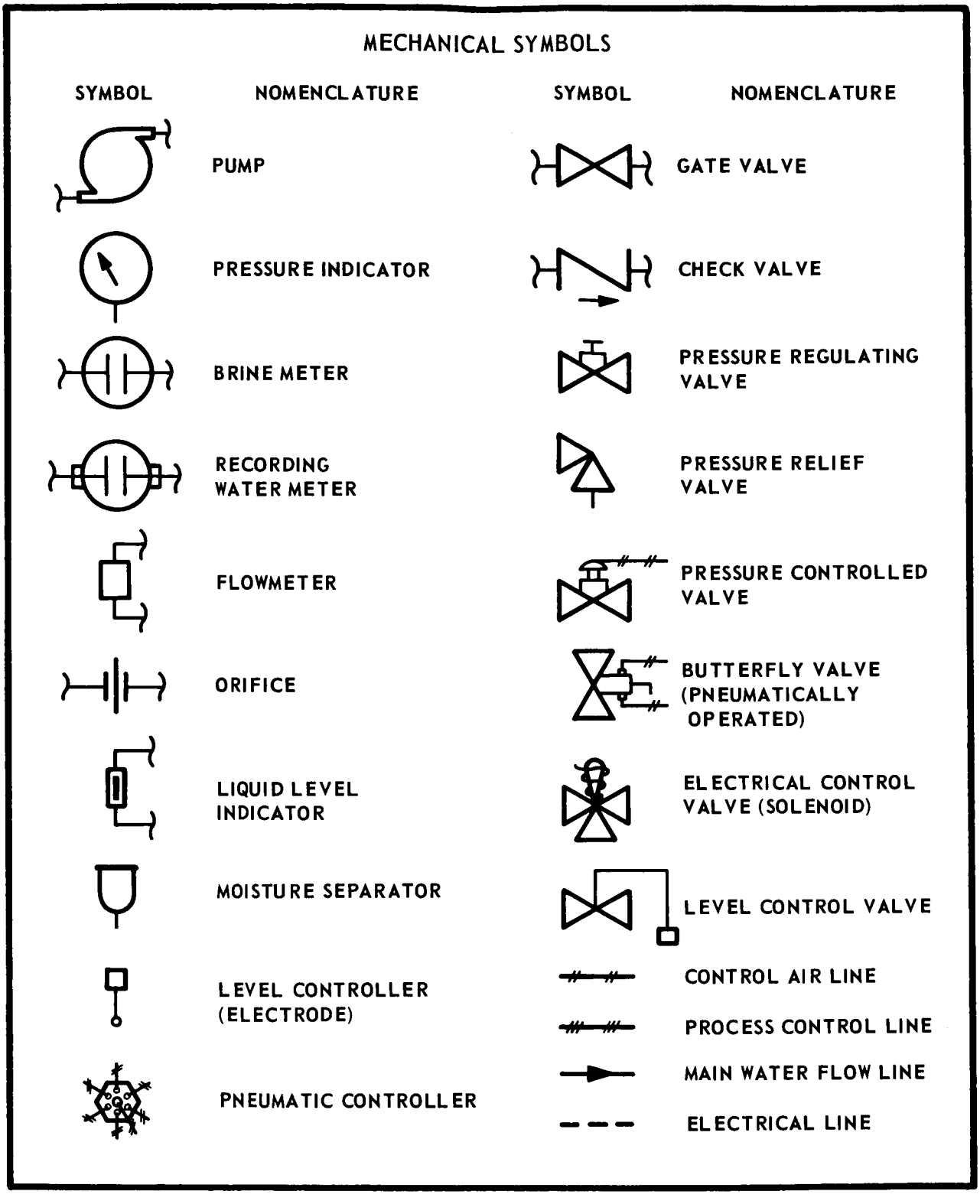


Figure 5-4. Water Softener System Mechanical Symbols

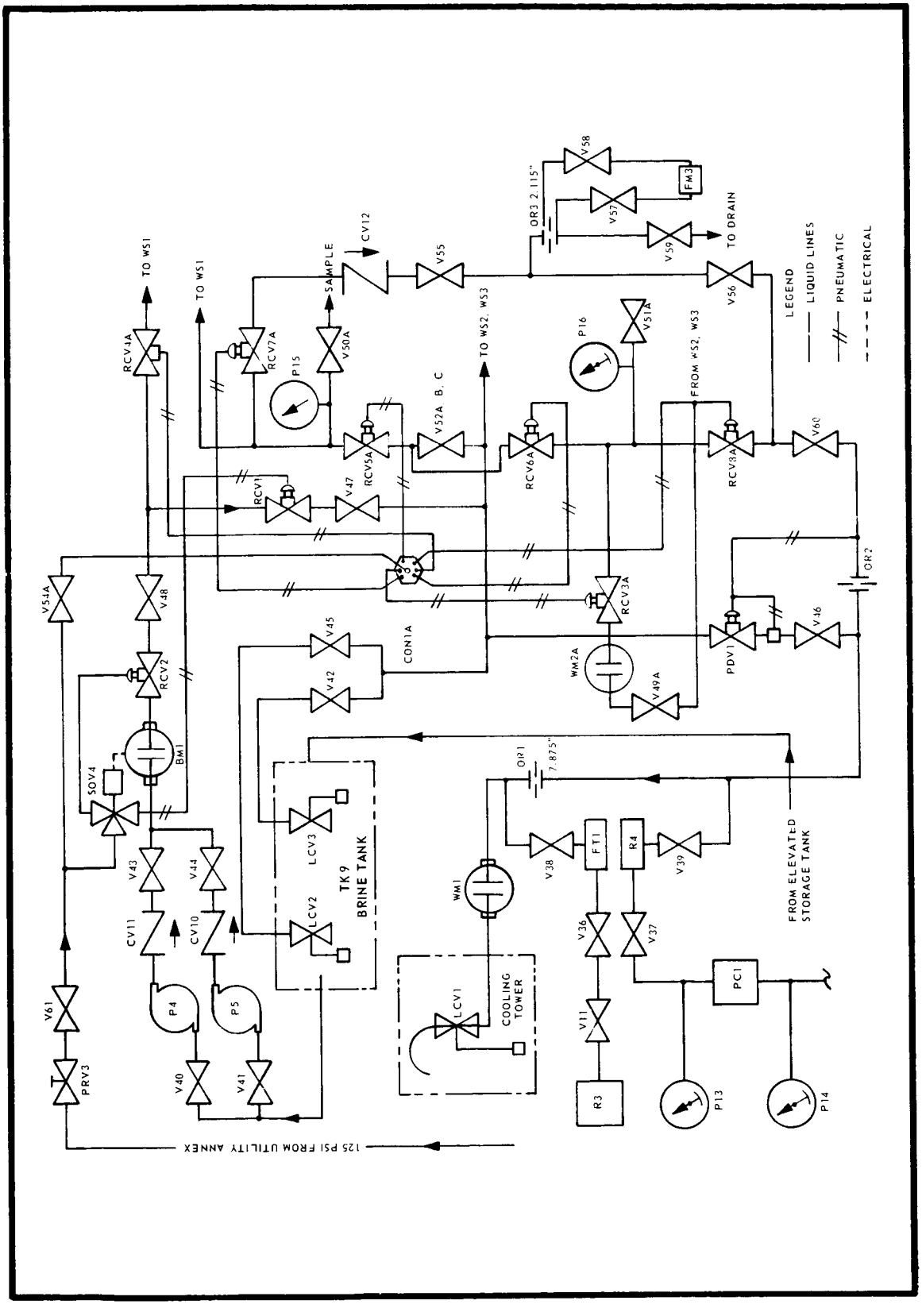


Figure 5-5. Water Softener System Schematic Diagram (Sheet 1 of 2)

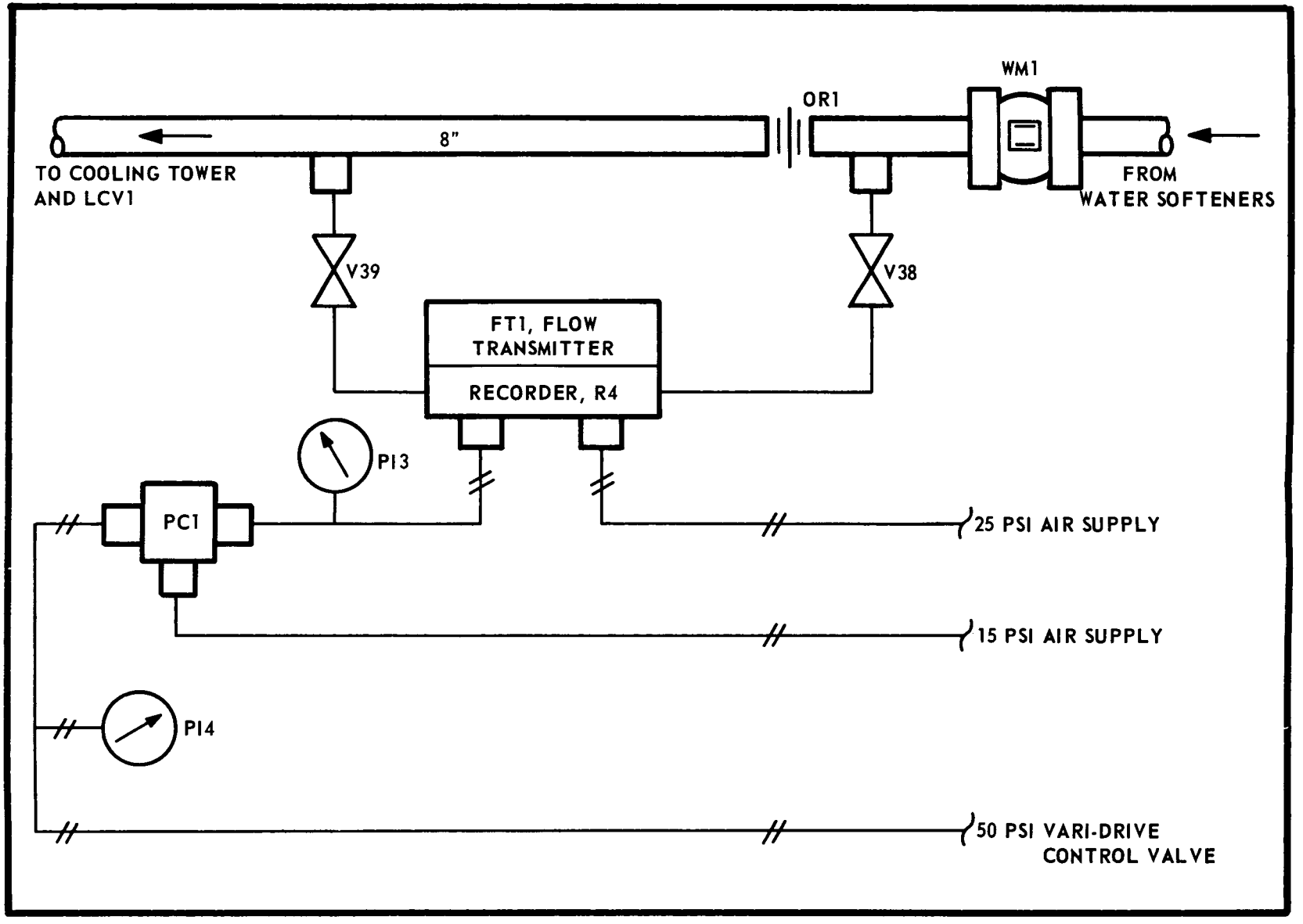


Figure 5-5. Water Softener System Schematic Diagram (Sheet 2 of 2)

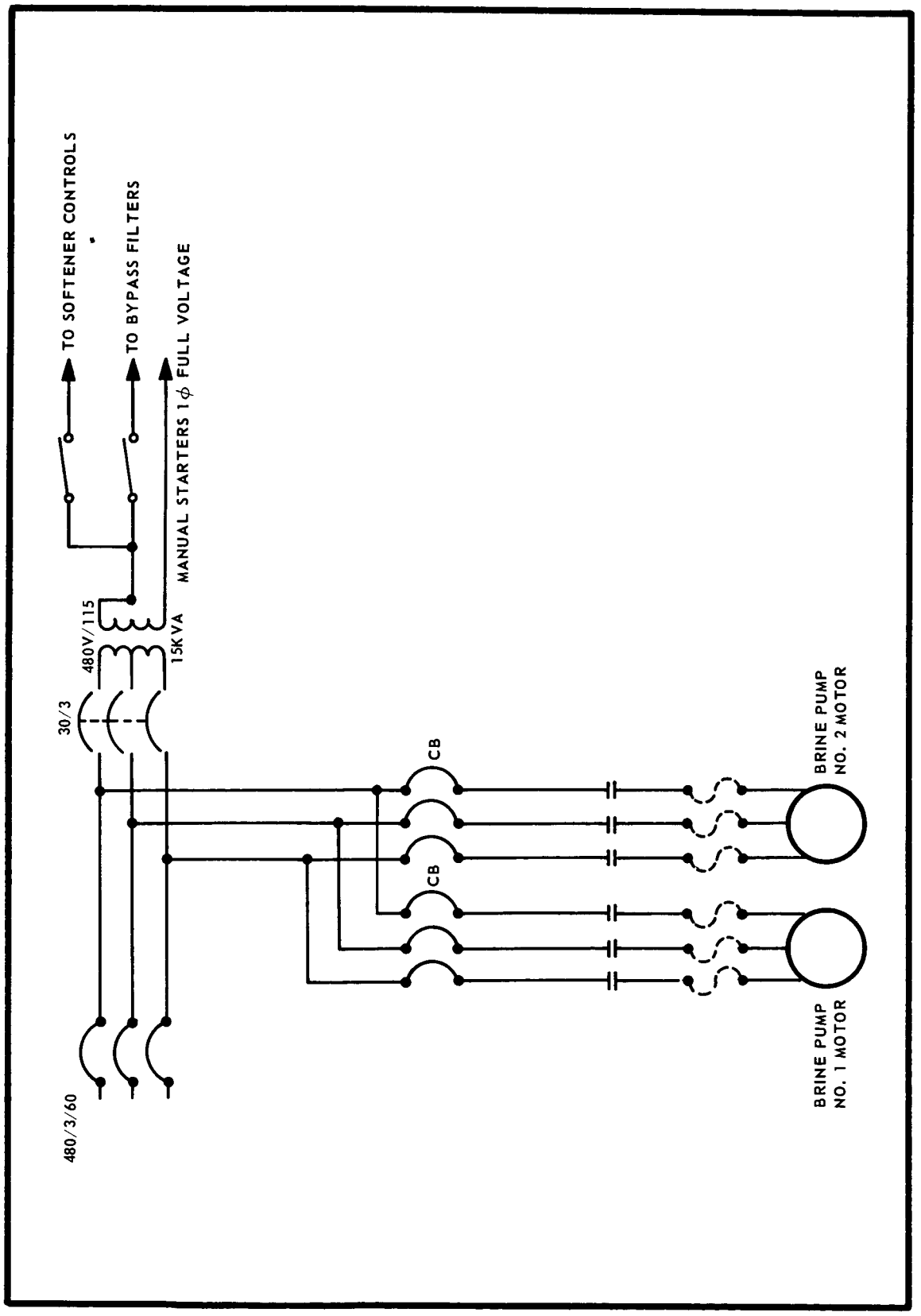
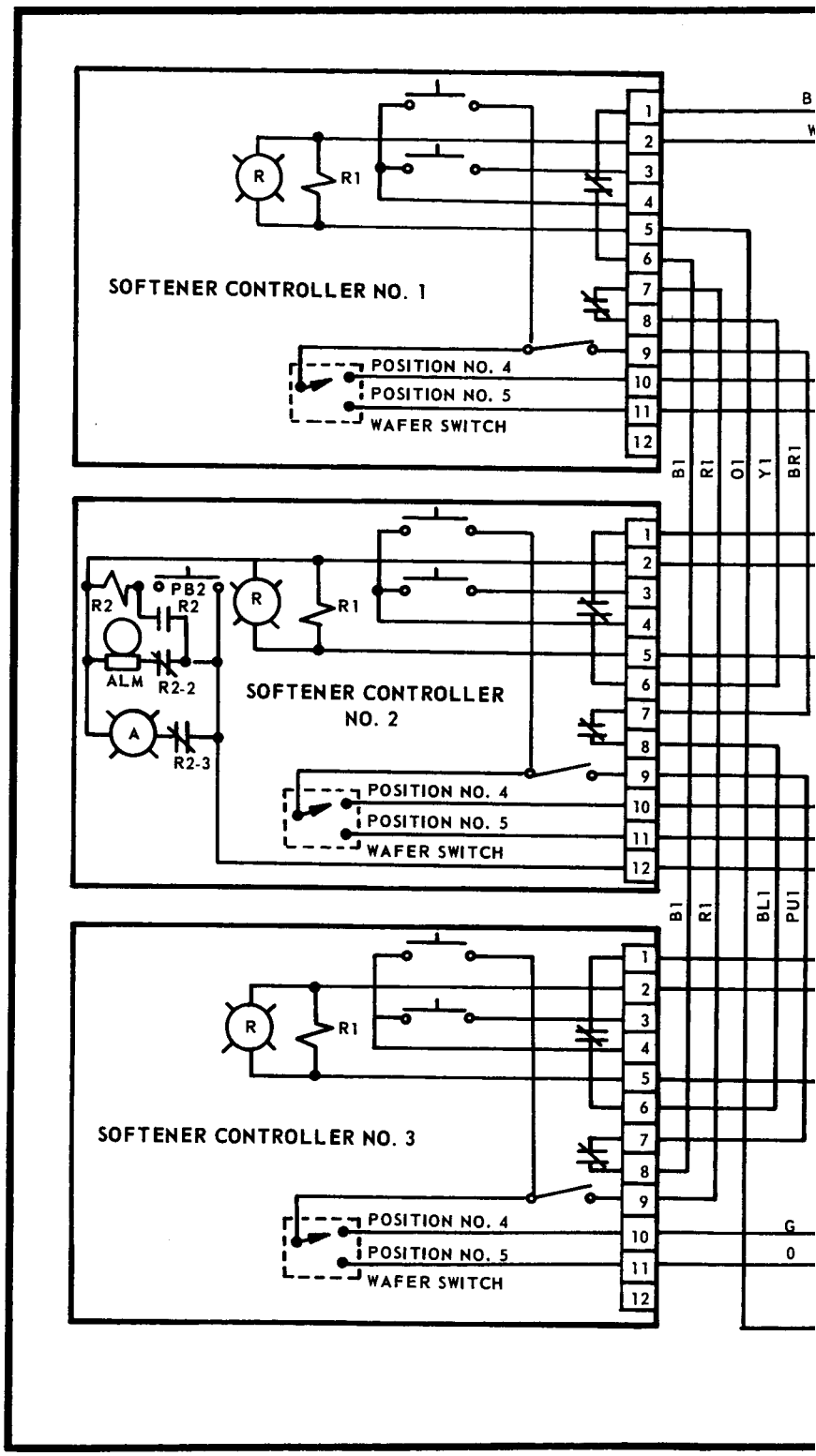


Figure 5-6. Water Softener System Power Wiring Diagram

Table 5-3. Water Softener System Coding

Code	Item Identification
BF	Butterfly Valve
BM	Brine Meter
BPF	Bypass Filter
C	Pneumatic Controllers
CV	Check Valve
F	Filter
FCV	Float Control Valve
FM	Flowmeter
PDV	Pressure Differential Valve
PI	Pressure Indicator
P	Pump
RCV	Remote Control Valve
WM	Water Meter
TK	Tank


SOFTENER CONTROLLER NO. 1
R
R1
POSITION NO. 4
POSITION NO. 5
WAFER SWITCH
1
2
3
4
5
6
7
8
9
10
11
12
B1
R1
O1
Y1
BR1
SOFTENER CONTROLLER NO. 2
R2
PB2
R2
ALM
R2-2
A
R2-3
BL1
PU1
SOFTENER CONTROLLER NO. 3
G
O

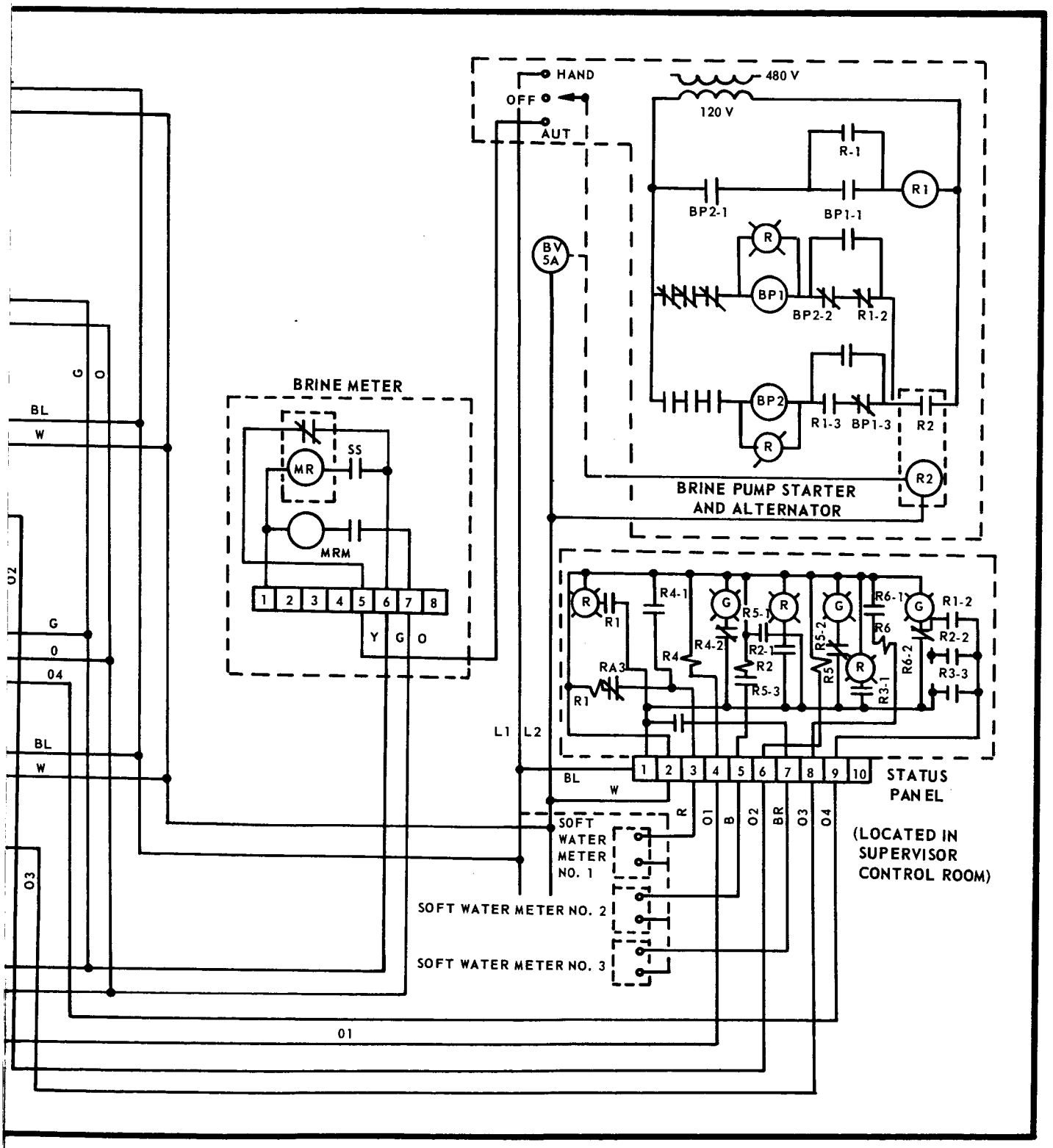


Figure 5-7. Water Softener System Wiring Diagram

Table 5-4. Significant Water Softener System Components

Component	Description
BRINE TANK (BRINE LIXATOR) TK9	
Capacity	
Salt	
Quantity (Approx Per Section)	12-1/2 ton
Type	Grade 1
Water (With Salt Added)	
High Level	6 in. below top
Gravel	
Type	1/2-in. to 3/4-in. rock quartz
Quantity	60 cu ft
Float Valves LCV2 and LCV3	
Type	Angle, float controlled
Operation	Hydraulically operated diaphragm
Dimensions (Approx Per Section)	
Width	6 ft
Length	10 ft
Depth	12 ft

Table 5-4. Significant Water Softener System Components (cont)

Component	Description
BRINE PUMP(S) P4 OR P5	
Type	Side suction, single stage, centrifugal
Head	50 ft
Capacity	50 gpm
Weight (Including Motor)	150 lb
Motor	
HP	3
RPM	1750
Voltage	440 volts, 3 phases, 60 cycles
BRINE METER BM1	
Type	Disc, registering
Function	Automatic reset controller
Working Pressure	50 psig
Weight	5 lb
Voltage	120 volts, 1 phase, 60 cycles
Dial	
Size	6 in.
Range	1000 gal
SOLENOID VALVE SOV4	
Type	Electrical; 3 way
Weight (Approx)	2 lb
Voltage (Coil)	120 volts, 1 phase, 60 cycles

Table 5-4. Significant Water Softener System Components (cont)

Component	Description
WATER SOFTENER(S) WS1, WS2 OR WS3	
Softening Capacity (Per Unit, Per Cycle)	228,000 gal
Flow Rate (Max , Per Unit)	312 gpm
Salt (Used Per Softener, Per Regeneration)	1710 lb
Resin	
Type	Duolite C-20 polystyrene
Capacity (Per Unit)	285 cu ft
Control Valves	
Type	Air operated, diaphragm actuated
Weight	36 lb
Pressure Indicators	
Type	Standard pressure gage
Dial	
Size	4-1/2 in.
Range	0-100 psi
TANK TK10	
Height (Approx)	15 ft
Diameter (Approx)	8 ft

Table 5-4. Significant Water Softener System Components (cont)

Component	Description
TANK TK10 (CONT)	
Material	
Type	Steel
Thickness	3/8 in.
WATER METER(S) WM2	
Flow Rate, Max	350 gpm
Length (Approx)	24 in.
Width (Approx)	13-5/8 in.
Height (Approx)	30-7/8 in.
Weight (Approx)	255 lb
Voltage	120 volts, 1 phase, 60 cycles
Dial	
Size	6 in.
Range	400,000 gal
BLEND VALVE PDV1	
Type	Differential pressure controlled
Operation	Hydraulically operated diaphragm
Weight	2-1/2 lb

Table 5-4. Significant Water Softener System Components (cont)

Component	Description
BLEND VALVE PDV1 (CONT)	
Differential Controller	
Type	Diaphragm, hydraulic balance
Strainer	
Type	Monel, self-cleaning

5.4.7 REGENERATION CYCLE. The following procedure shall be used to regenerate the water softeners system:

a. Depress, then release ALARM silence pushbutton switch PBI.

b. Verify that brine tank TK9 supply valves V42 and V45 are open.

c. Verify that brine pumps P4 and P5 isolation valves V40, V41, V43, and V44 are open.

d. Verify that brine meter BM1 is reset to specified indication.

e. Verify that salt is visible in tank TK9, or perform hydrometer test.

f. Verify that valves V57 and V58 are open.

g. Verify that valve V59 is closed.

h. Reset water meter WM2 movable pointer to indicate 228,000 gallons.

i. Depress START pushbutton switch PB1 on controller for water softeners WS1, WS2, or WS3.

j. When 16 minutes have elapsed after START pushbutton switch PB1 is energized, observe the following:

1. Controller stager valve has moved to position 3, then 4

2. Brine pump P4 or P5 operates

3. Brine meter BM1 registers brine flow (between 0 and 684 gallons)

4. Flowmeter FM3 indicates 41 gallons flow to drain

k. When brine meter BM1 registers 0 gallons, observe the following:

1. Solenoid valve SOV 4 operates

2. Brine pump operation ceases

3. Flowmeter FM3 indicates 65 gallons flow to drain

l. When 42 minutes have elasped after start of brine pump, observe the following:

1. Controller stager valve is moved to position 5

2. Solenoid valve SOV 4 operates

3. Flowmeter FM3 indicates 320 gallons to drain

m. When 15 minutes have elapsed after controller stager valve has moved to position 5, observe the following:

1. Controller stager valve is moved to position 0

2. PI5 indicates 50 $\pm$ 5 psi, PI6 indicates 46 $\pm$ 5 psi

3. Brine meter resets to indicate 684 gallons

5.4.8 PREVENTIVE MAINTENANCE. Preventive maintenance procedures include periodic inspections, cleaning, adjustment, alignment, calibration, lubrication, and servicing of system and components.

5.4.9 STORAGE. Storage of salts, recorder charts, and any necessary expendable items shall be based on a 30-day stock supply in the work area.

5.4.9.1 Spare Parts. Spare parts shall be stored in such place and manner that parts shall be readily available for immediate pickup when an emergency arises.

SECTION VI
SEWAGE TREATMENT SYSTEMS

6.1 PURPOSE

The purpose of this procedure is to establish instructions for the operation and maintenance of the sewage disposal and water treatment systems for the Launch Complex 39 (LC-39) area.

6.2 PLANT NO. 1 BUILDING M6-895

(Information to be supplied)

6.3 PLANT NO. 2 BUILDING M7-1162

(Information to be supplied)

6.4 PLANT NO. 3 BUILDING N6-2296A

(Information to be supplied)

6.5 PLANT NO. 4 BUILDING K6-792

6.5.1 SYSTEM DESCRIPTION. The sewage disposal system is a self-contained air diffusion type, which biologically treats raw influent. After system processing it is expelled as effluent into the Banana Creek. The system consists of two lift stations and a continuous duty treatment plant. During each 24-hour period 216,000 gallons of raw influent can be handled. The system services the Launch Control Center (LCC), the high and low bays of the VAB, the Utilities Annex, and the Launch Equipment Shop (LES).

6.5.2 REFERENCE MATERIAL. A general description of this system is provided in TM4-143-39 Sewage Treatment System, LC-39 Vertical Assembly Building Service and Maintenance manual published by the National Aeronautics and Space Administration (NASA) Technical Information Office. Drawings of the system (LC-39) are in NASA VAB drawings 203-100 sheets 32-04 through 32-14.

6.5.3 RESPONSIBILITY FOR OPERATION AND MAINTENANCE. The operation of the system is the responsibility of the Base Support Services Contractor (BSSC) Base Utilities Section. Preventive maintenance is preformed by BSSC maintenance service.

6.5.3.1 Operation. Operating personnel are responsible for collecting influent and effluent each day of the normal work week and submitting the samples for chemical analysis. Records shall be kept and test results of purity shall be maintained within acceptable limits as determined by the Florida State Health and Sanitation Laws. Operators are responsible for maintaining daily log books for the system and it shall also be their responsibility to immediately notify the responsible foreman of any unusual occurrence. The foreman shall issue special instructions to the operating personnel in the event of a temporary change in procedure.

6.5.3.2 Preventive Maintenance. Preventive maintenance shall be performed by BSSC maintenance personnel. Maintenance shall be performed on a scheduled basis in accordance with preventive maintenance instructions issued by BSSC preventive maintenance engineering.

6.5.3.3 Equipment Malfunction or Failure. In the event of equipment malfunction or failure, the operating personnel will isolate the problem area and complete a temporary repair to ensure uninterrupted service.

6.5.4 OPERATING INSTRUCTIONS AND PROCEDURES. Operating instructions and procedures for the Sewage Treatment Plant are shown in paragraphs 1-27 through 1-36 of TM4-143-39. The instructions are a step-by-step procedure following paragraph 1-36 of Section I (TM4-143-39). These instructions are augmented by BSSC preventive maintenance engineering information issued to the BSSC Base Utilities Section and will be titled Operating Instructions and Line-O-Gram. These will be physically located at Plant No. 4 Building K6-792. Specific operation instructions and procedures will include the following:

1. Operation Instructions - Safety
2. Routine Operation Procedures - Daily
3. Routine Operation Procedures - Weekly
4. Sewage Sample Collection and Analysis Schedule
5. Dewatering Operation - Aerator and Clarifier
6. Returning Dewatered Units to Service - Aerator and Clarifier
7. Equipment Inspection - Dewatering Clarifier
8. Dewatering Chlorine Contact Tank
9. Electrical Power Failure Procedure

6.5.4.1 Operating Instructions (Safety). When performing assigned duties, all operators shall at all times observe the prescribed safety directives displayed in safety bulletins and follow safe practice standards. The Foreman's specific safety instructions will also be followed.

6.5.4.2 Routine Operation Procedure (Daily) (Figure 6-1).

a. The first shift operator (graveyard shift) will change the recording charts on the:

1. Plant Influent Recorder
2. Plant Effluent Recorder

b. The second shift operator (day shift), when starting work shift, will place next-in-sequence blowers and pumps in AUTO position and reset past sequenced blowers and pumps to OFF.

c. The operator will collect required samples (refer to paragraph 6.5.4.5) at start of shift and immediately submit to laboratory chemist.

d. The operator will record the results of analysis in both the permanent bound log and the laboratory log.

e. The operator will make appropriate entries in equipment logs for the following equipment on each shift:

1. Sewage Lift Pumps No. 1 (P2) and No. 2 (P3)
2. Blowers B1 and B2
3. Water Pumps P4
4. Froth Spray Pumps P5 and P6
5. Comminutor MSH 1
6. Chlorinator
7. Sludge Collector

f. The operator will record all equipment and operational changes or modifications in the Operator's Log during the day shift.

g. The operator will perform a general visual inspection to ensure the proper functioning of:

1. All equipment during day shift
2. All equipment to which access is permitted during other shifts

NOTE

Any discrepancies or malfunctions shall be reported immediately to the Foreman and then recorded in the Operator's Log.

6.5.4.3 Routine Operation Procedure (Weekly) (Figure 6-1).

a. Operate the following equipment during out-of-service periods:

1. Sludge collector drive during 1-day shift
2. Froth spray pumps for a period of 4 hours during day shift

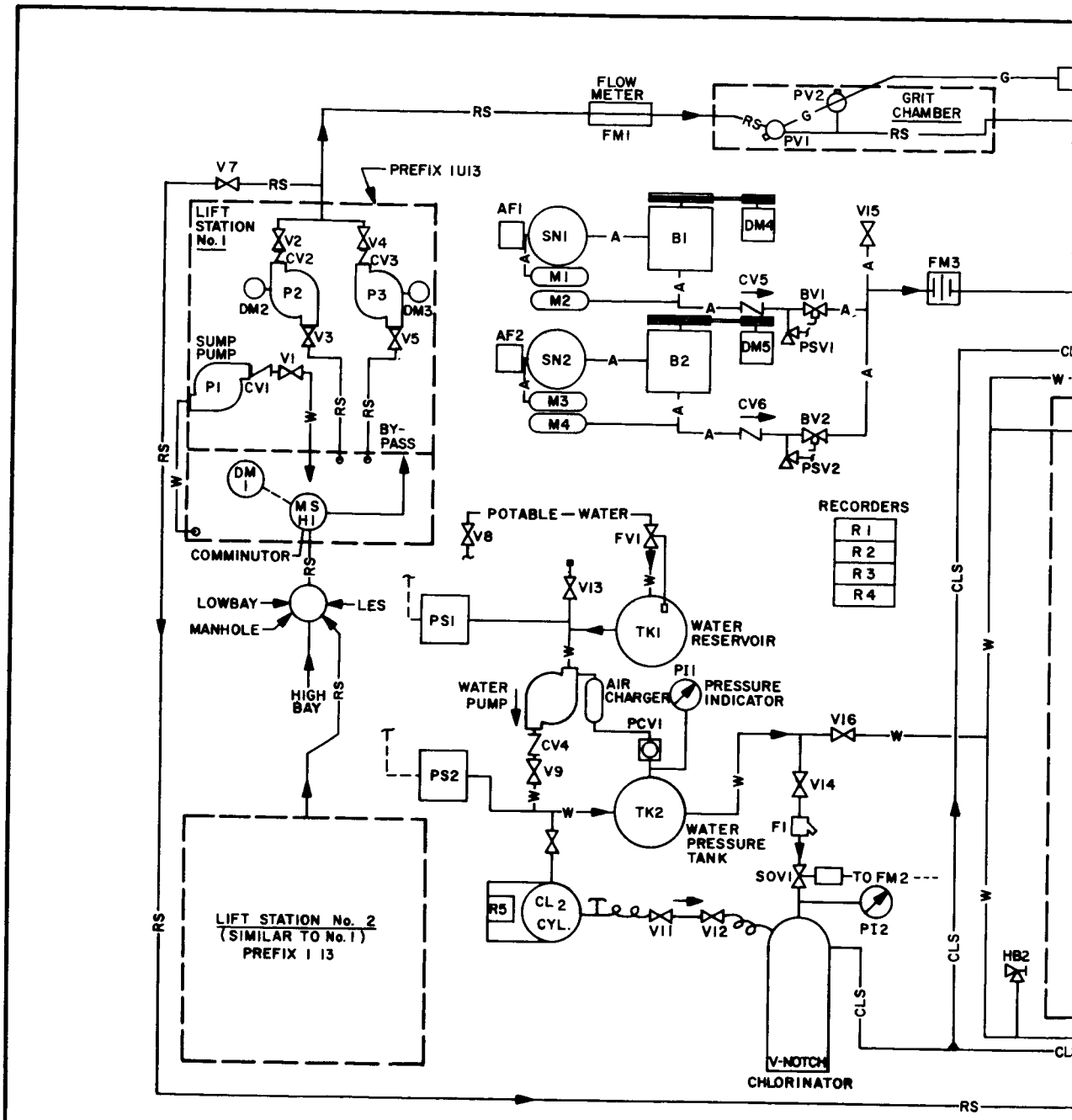
b. Flush grit chamber of waste contents with clean water. Dispose of contents through mud valves or as directed by foreman.

6.5.4.4 Sewage Sample Collection and Analysis Schedule. Tables 6-1 and 6-2 show the sewage sample collection and analysis schedules which include frequencies, quantities, sample sources, and specimens to be analyzed.

Table 6-1. Sewage Sample Collection-Building K6-792

Frequency	Sample Quantity (Liters)	Sample Source
Daily	4	Influent
Daily	4	Effluent
Daily	4	Aeration
Monthly	4	Receiving Stream

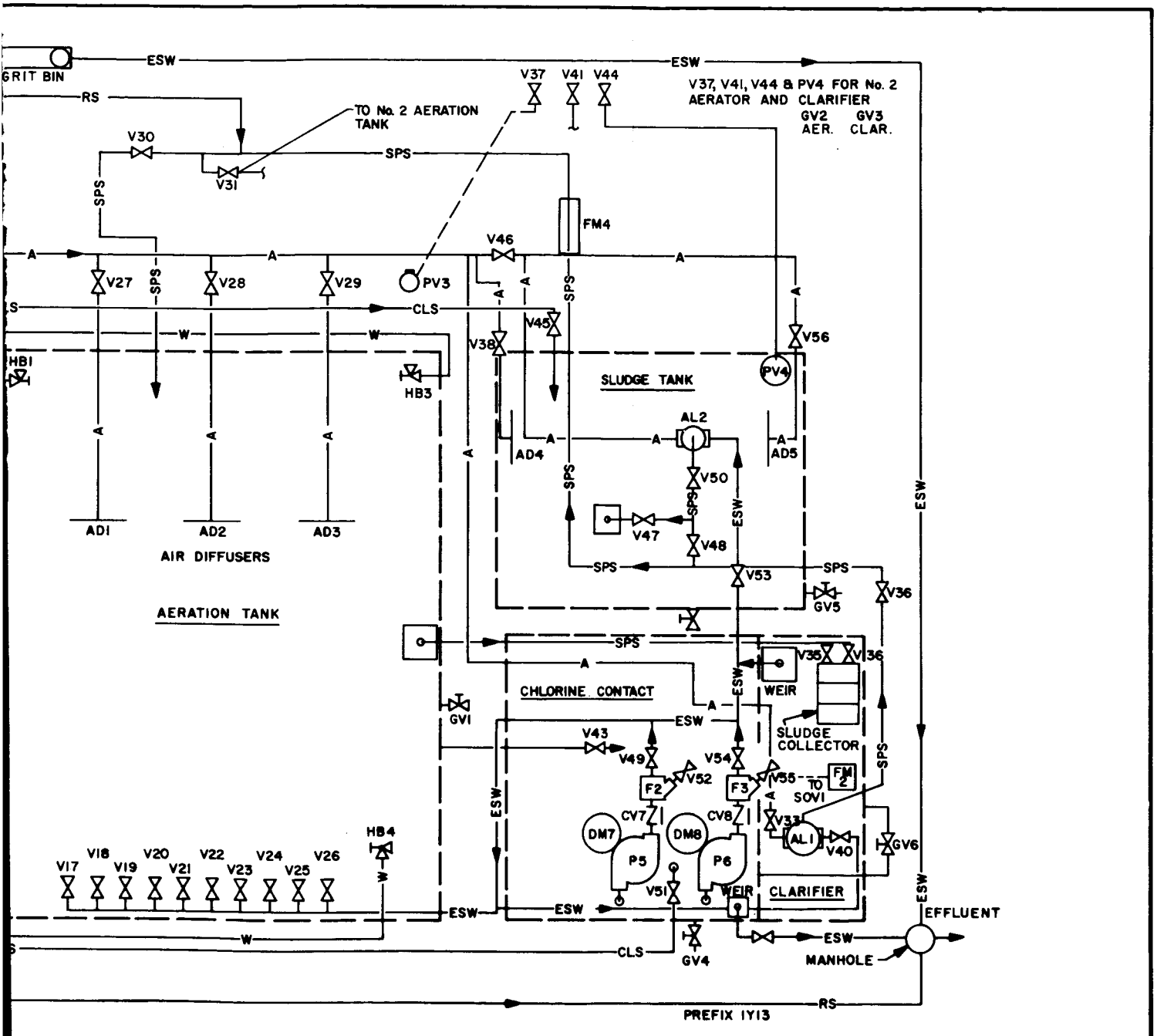
NOTE: Since analysis results are intended to reflect actual operating conditions and overall effectiveness of treatment, the foreman will vary sample specimens and increase frequency of collection as plant conditions vary.



RS	RAW SEWAGE
SPS	SLUDGE AND PARTLY TREATED SEWAGE
A	AIR
ESW	EFFLUENT AND SPRAYWATER
W	WATER
CLS	CHLORINE SOLUTION
G	GRIT

LEGEND

AD	AIR DIFFUSER
AL	AIRLIFT
AF	AIR FILTER
B	BLOWER
BV	BUTTERFLY VALVE
C	COMPRESSOR
CV	CHECK VALVE



—DRIVE MOTOR
—FLOW METER
—FILTER
—FLOAT VALVE
—SHEAR GATE VALVE
—HOSE BIB
—COMMINUTOR

PI —— PRESSURE INDICATOR
P —— PUMP
PS —— PRESSURE SWITCH
PV —— PLUG VALVE
PSV —— PRESSURE SAFETY VALVE
SOV —— SOLENOID OPERATED VALVE
TK —— TANK
V —— VALVE

Figure 6-1. Water Treatment System - Plant No. 4 Building K6-792

Table 6-2. Analysis Schedule - Building K6-792

Frequency	Analysis	Sample Source
Daily	pH	Influent, Effluent, Aeration
Daily	Chlorine Residual	Effuent
Twice-Weekly	Dissolved Oxygen	Influent, Effluent, Aeration
Twice-Weekly	Total Solids at 130° C	Influent, Effluent, Aeration
Twice-Weekly	Settleable Solids	Influent, Effluent, Aeration
Twice-Weekly	Suspended Solids	Influent, Effluent, Aeration
Twice-Weekly	Sludge Volume Index	
Twice-Weekly	Biochemical Oxygen Demand	Influent, Effluent, Aeration
Monthly	Dissolved Oxygen	Receiving Stream
Monthly	Biochemical Oxygen Demand	Receiving Stream
Monthly	Nitrogen	Influent, Effluent, Aeration

NOTE: The analysis will be performed by a qualified chemist using only representative samples according to the American Public Health Associations standard method.

6.5.4.5 Dewatering Operation - Aerator and Clarifier (Figure 6-1). The following procedure refers to Aerator No. 1 and Clarifier No. 1. The procedure is also applicable to Aerator No. 2 and Clarifier No. 2.

a. Secure surface spray pumps, if operating, and set HAND-OFF-AUTOMATIC (H-O-A) selector switch for operating blowers to HAND position.

NOTE

Prior to performing step b, make certain gate valve No. 13 of Aerator No. 2 is open.

b. Close gate valve V30 and open drain valve V43 of Aerator No. 1.

c. Operate Clarifier No. 1 sludge air lifts (air valves V27, V28, and V29 at maximum capacity).

d. Turn air valves (AD1, AD2, and AD3) of Aerator No. 2 to full open position.

e. When liquid levels in the Aerator and Clarifier are equal, open shear gate valve G-V1 of Aerator No. 1 and start washing down tank being drained with clear water.

f. Close air valves of Aerator No. 1 and adjust air valves of Aerator No. 2 for desired delivery.

g. Secure collector drive and air lift AL1 of Clarifier No. 1 when tanks are drained and cleaned. Return H-O-A selector switch to AUTO position.

h. Close drain valve V43 of Aerator No. 1 and refill units (which have been cleaned) with potable water. When liquid level in Clarifier No. 1 reaches operating level, close shear gate valve GV1 of Aerator No. 1 and continue filling Aerator No. 1 to operating level.

6.5.4.6 Returning Dewatered Units to Service-Aerator and Clarifier (Figure 4-1). The following procedure refers to Aerator No. 1 and Clarifier No. 1. The procedure is also applicable to Aerator No. 2 and Clarifier No. 2.

a. Place H-O-A selector switch of operating blowers in HAND position.

b. Open gate valve V30 of Aerator No. 1 and close gate valve V31 of Aerator No. 2.

c. Turn off Clarifier No. 2 airlift AL4 and adjust Clarifier No. 1 airlift AL1 for routine operation.

d. Adjust air valves (air diffusers) of both Aerators for routine operation.

e. Start Clarifier No. 1 sludge collector drive.

f. Operate froth spray system (if required) while units are being returned to service.

g. Continue plant operation for a period of 12 hours. At this time Aerator influents will be balanced (V30 and V31) for routine operation.

h. Return H-O-A selector to AUTO position and adjust Clarifier No. 2 air lift AL4 for routine operation.

6.5.4.7 Equipment Inspection - Dewatering Clarifier (Figure 6-1). The following operational procedure concerns Clarifier No. 1 but is typical of similar units. Immediately prior to scheduled Clarifier preventive maintenance inspection, the following operations will be performed.

a. Set operating blower H-O-A selector switch to HAND position.

b. Close gate valve V30 of Aerator No. 1.

c. Operate sludge airlift AL1 of Clarifier No. 1 at maximum capacity and start washing walls with clean water.

d. Turn off sludge collector drive and airlift AL1 after Clarifier No. 1 is drained and cleaned.

e. On completion of preventive maintenance task, close valve V31 of Aerator No. 2 and open valve V30 of Aerator No. 1.

f. Restore sludge collector drive and airlift AL1 to routine operation.

g. When Clarifier No. 1 attains operating liquid level, balance (V30 and V31) influents for routine operation and return blower H-O-A selector switch to AUTO position.

6.5.4.8 Dewatering Chlorine Contact Tank (Figure 6-1). The following procedure will be performed to dewater the chlorine contact tank.

a. Stop surface spray pumps, if operating, and position H-O-A selector switch of operating blowers to HAND.

b. Note feed rate of chlorinator, open bypass valve, and manually set chlorinator to maximum feed rate (100 lb/24 hours).

c. Open shear gate valve GV4 and tank drain valve GV6.

d. When liquid levels in Aeration and Clarifier tanks are equal, close gate valve GV1.

e. While chlorine contact tank is draining, wash down walls with clean water.

f. After chlorine contact tank has been cleaned and inspected, close tank drain valve GV4 and bypass valve. Manually reset chlorinator to original feed rate (step b).

g. When liquid level in Aeration tank reaches operating level, return H-O-A selector switch of operating blowers to AUTO position and return froth spray pumps to service when desired.

6.5.4.9 Electrical Power Failure Procedure. In the event of an electrical power failure or a low voltage condition occurring during any shift, the following procedure will be initiated at the motor control center (Figure 6-2).

a. Check all circuit breakers and determine if power outage has been caused by a malfunction on the load side of the main circuit breakers or any secondary circuits.

b. If a malfunction is discovered in a secondary circuit and an individual circuit breaker has tripped, attempt to reset the circuit breaker.

c. If the main circuit breaker has tripped, attempt to reset main circuit breaker.

d. If it is determined that the main power supply has failed and power outage will continue for an extended period of time, emergency power must be supplied by a portable engine-generator set rated at 480 volts, 3 phases, 60 cycles. Connection terminals are provided outside of the motor control center room.

e. Prior to transfer from normal to emergency power supply, check that phase rotation of emergency power supply is the same as normal supply.

NOTE

The maximum demand permitted by the emergency circuit breaker is 100 amperes. If the emergency generator cannot meet this current requirement (is less than 100 amperes) at initial closing of emergency circuit breaker (step g), make certain that the entire plant electrical power load is not applied at one time.

f. Lock OPEN main circuit breaker of normal supply.

g. Unlock and close emergency main circuit breaker (see note step e).

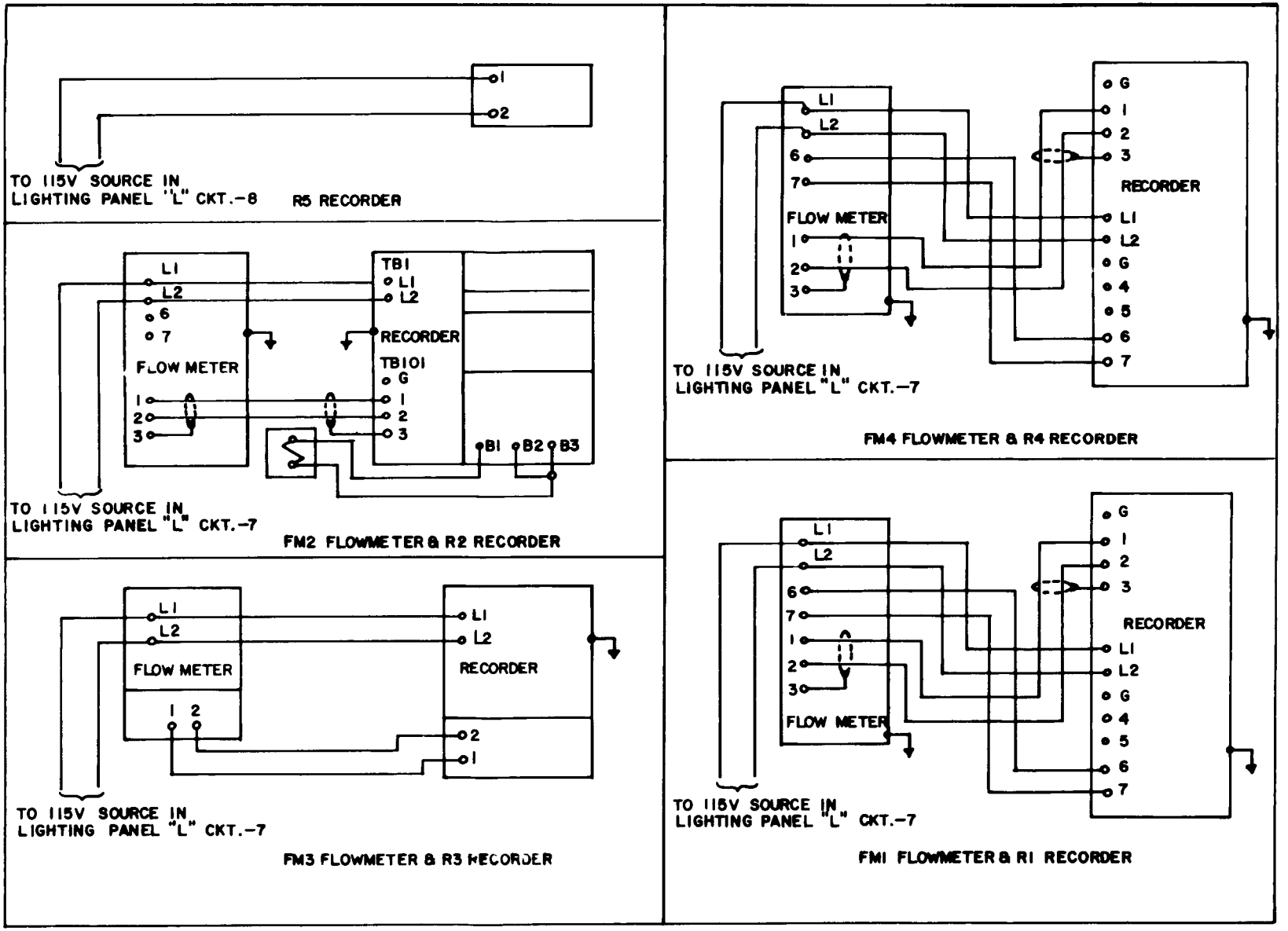


Figure 6-2. Electrical Power Circuit - Building K6-792 (Sheet 1 of 3)

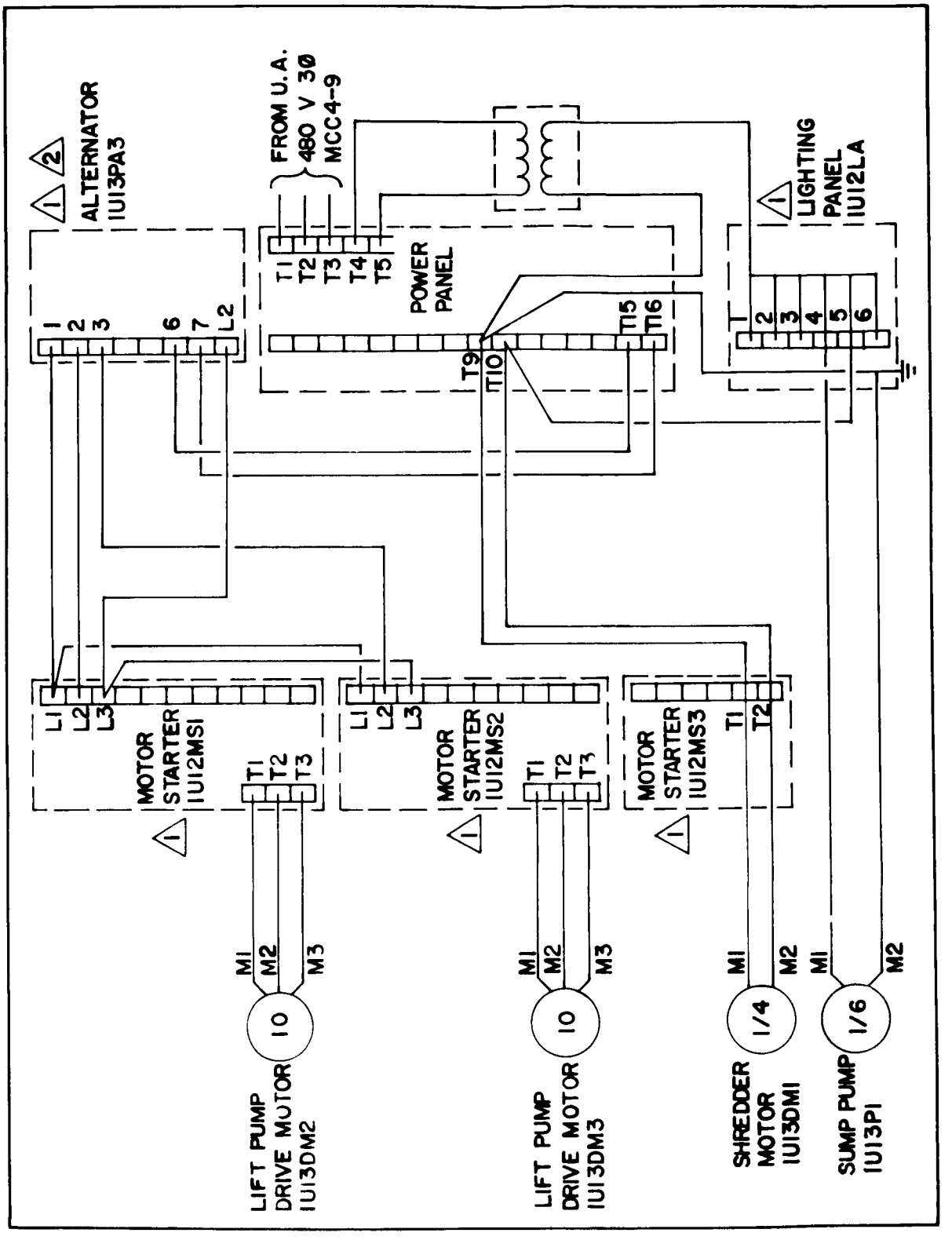


Figure 6-2. Electrical Power Circuit - Building K6-792 (Sheet 2 of 3)

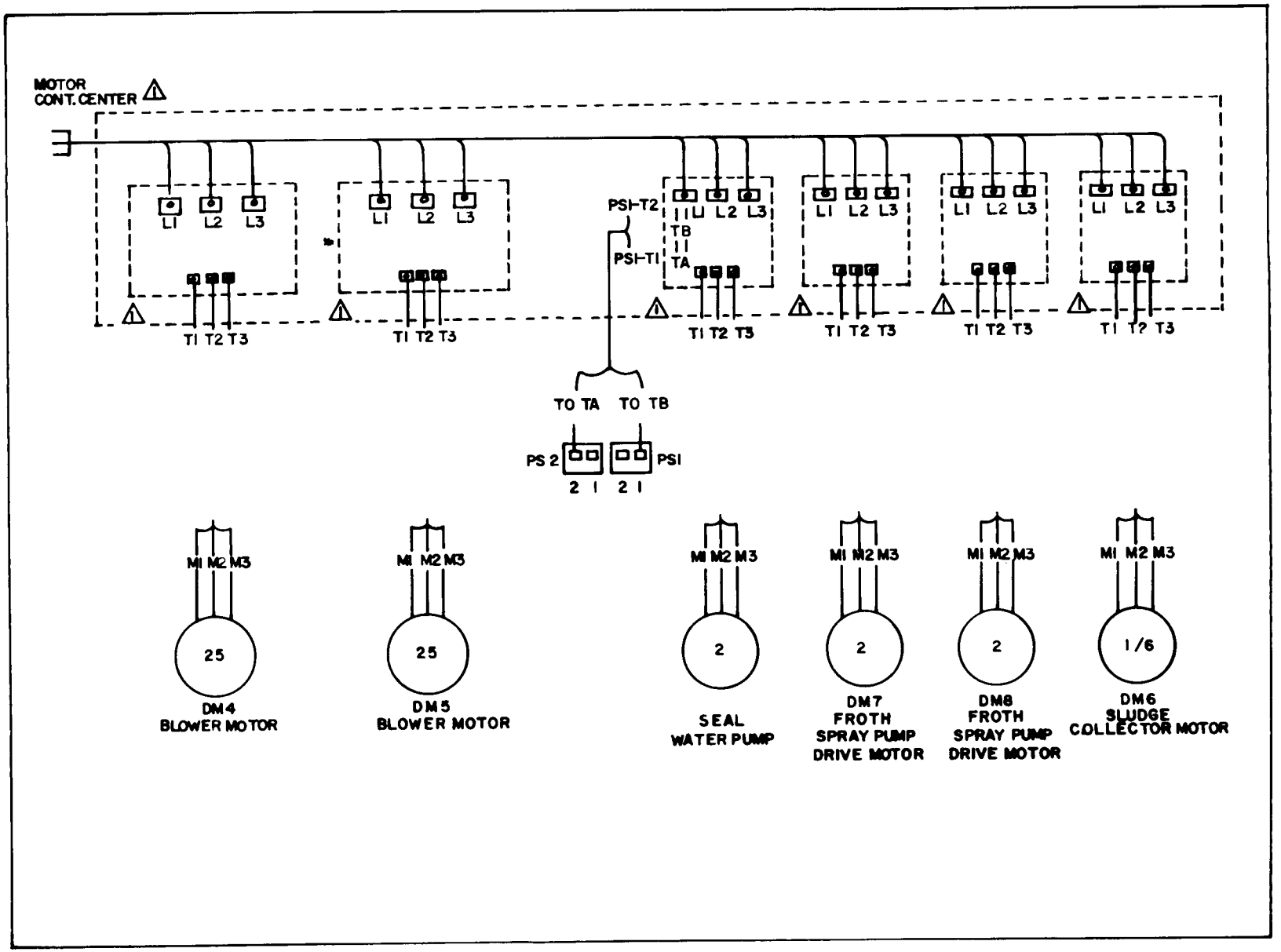


Figure 6-2. Electrical Power Circuit - Building K6-792 (Sheet 3 of 3)

h. When normal electrical power service is restored, lock OPEN emergency power main circuit breaker and close normal power supply main circuit breaker.

i. Disconnect portable generator and manually restart:

1. Sludge collector drive
2. Froth spray pumps

j. Inspect all driven equipment for proper operation.

6.5.5 PREVENTIVE MAINTENANCE. Preventive maintenance scheduling will be provided by BSSC Production Control. Preventive maintenance instructions concerning specific tasks will be provided by BSSC Maintenance Engineering. These instructions will provide information concerning periodic inspection and service, cleaning, adjustment, alignment, calibration, and lubrication. Normal maintenance will be performed on a scheduled basis, and corrosion control and painting shall be performed as required.

6.5.5.1 Failure and Malfunction Measures for Uninterrupted Service. Inspection and servicing schedules will be issued to respective foremen, to operators, and to maintenance technicians. Daily, weekly, monthly, quarterly, semi-annual, and annual log books shall be kept in accordance with the item or component requiring inspection or service.

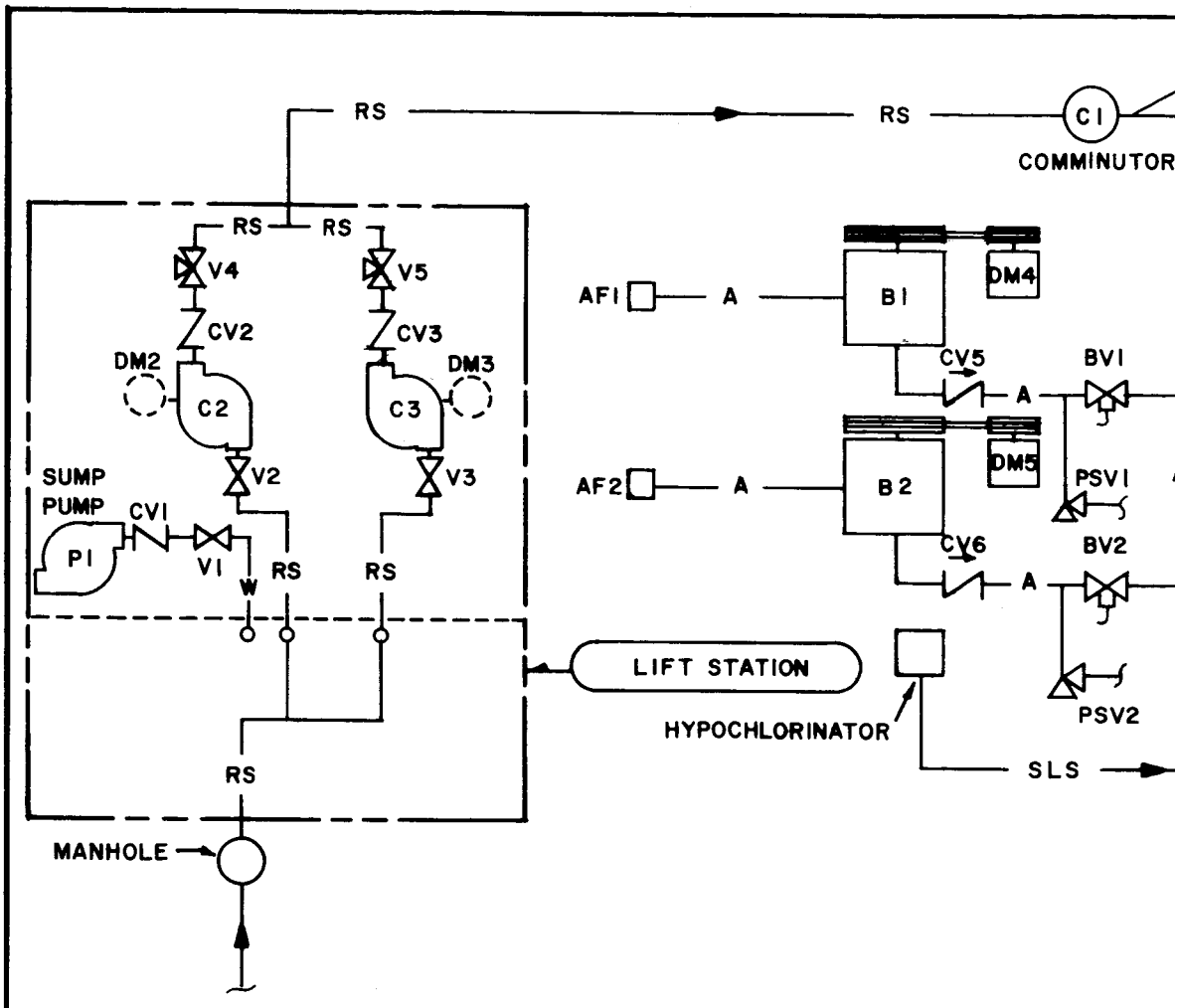
6.5.5.2 Failure or Malfunction Instructions. In the event of an equipment malfunction or failure, the operating personnel will isolate the problem area and complete a temporary repair to ensure uninterrupted service. A permanent repair will be completed at the earliest possible date on a scheduled equipment down-time basis.

6.5.5.3 Storage. Chemicals, recorder charts, and any necessary expendable material shall be based on a 30-day available supply for the sewage plant. The material shall be readily available for daily control and pickup.

6.5.5.4 Spare Parts. Spare parts shall be stored in a place and manner so that parts shall be readily available for immediate pickup when an emergency arises.

6.6 PLANT NO. 5 BUILDING J8-1705

6.6.1 SYSTEM DESCRIPTION. This sewage system provides a means of receiving raw influent through a piping network and a lift station. It is then processed at the biological treatment plant at Building J8-1705. From there it is expelled as



LEGEND:

—RS—	RAW SEWAGE	FV	FLOAT VALVE
—SPS—	SLUDGE & PARTLY TREATED SEWAGE	GV	SHEAR GATE VALVE
—A—	AIR	HB	HOSE BIB
—ESW—	EFFLUENT & SPRAY WATER	MSH	COMMINUTOR
—W—	WATER	PI	PRESSURE INDICATOR
—SLS—	CHLORINE SOLUTION	P	PUMP
—G—	GRIT	PS	PRESSURE SWITCH
AD	AIR DIFFUSER	PV	PLUG VALVE
AL	AIR LIFT	PSV	PRESSURE SAFETY VALVE
AF	AIR FILTER	SOV	SOLENOID OPERATED VALVE
B	BLOWER	TK	TANK
BV	BUTTERFLY VALVE	V	VALVE
C	COMPRESSOR		
CV	CHECK VALVE		
DM	DRIVE MOTOR		
F	FILTER		
FM	FLOW METER		

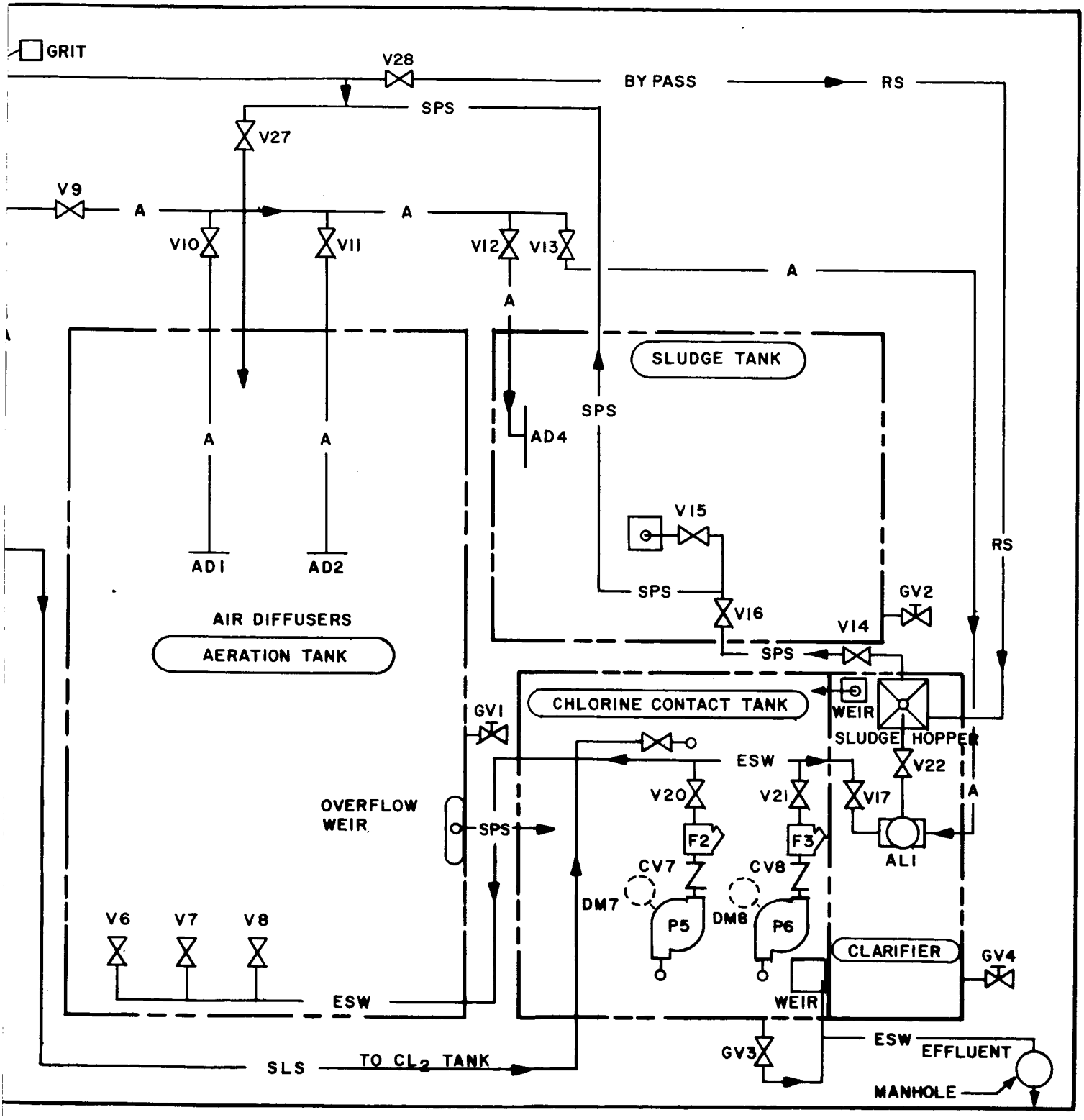


Figure 6-3. Water Treatment System - Plant No. 5 Building J8-1705

treated effluent into the Banana Creek. The lift station interconnecting piping and treatment plant is a self-contained system of the air diffusion type used to treat and process sewage for the Pad A area. The capacity of this plant is 9,000 gallons of raw sewage per day on a continuous workday basis with a scheduled shutdown for inspection, cleaning, and maintenance (see Figure 6-3).

6.6.2 REFERENCE MATERIAL. A detailed representation of this system is provided in Launch Complex 39 (LC-39) Vertical Assembly Building (VAB) drawing series 203-102 sheets 2043 through 2046, 2074, and 2147 through 2149.

6.6.3 RESPONSIBILITY FOR OPERATION AND MAINTENANCE. The operation of the system is the responsibility of the BSSC Base Utilities Section and the maintenance of the system is the responsibility of the BSSC maintenance service personnel.

6.6.3.1 Operation. The operating personnel are responsible for collecting influent and effluent samples each day of the normal work week and submitting these samples for chemical analysis. Analysis records of purity shall be maintained in accordance with the acceptable limits as determined by the Florida State Health and Sanitation Laws. Operators shall maintain daily log books for the system. The operators shall immediately notify the responsible foreman of any unusual occurrence. The foreman shall issue any necessary special instructions to the operating personnel in event of a temporary change in operating procedure.

6.6.3.2 Preventive Maintenance. Preventive maintenance shall be performed by BSSC maintenance personnel on a scheduled basis in accordance with preventive maintenance instructions issued by BSSC preventive maintenance engineering.

6.6.3.3 Equipment Malfunction or Failure. In the event of equipment malfunction of failure, the operating personnel will isolate the problem area and complete a temporary repair to ensure uninterrupted service.

6.6.4 OPERATING INSTRUCTIONS AND PROCEDURES. Operating instructions and procedures will be issued by BSSC preventive maintenance engineering to the BSSC Base Utilities Section and will be titled Operating Instructions and Line-O-Gram. These will be physically located at Plant No. 5 Building J8-1705. Specific operating instructions and procedures will include the following:

1. Operating Instructions - Safety
2. Routine Operation Procedure - Daily
3. Routine Operation Procedure - Weekly
4. Sewage Sample Collection and Analysis Schedule

5. Equipment Inspection
6. Electrical Power Failure Procedure

6.6.4.1 Operating Instructions (Safety). When performing assigned duties, all operators shall at all times observe the prescribed safety directives displayed in safety bulletins and follow safe practice standards. The foreman's specific safety instructions will also be followed.

6.6.4.2 Routine Operation Procedure (Daily).

a. The second-shift operator (day shift) will place next in sequence blowers, compressors, and pumps in AUTO position and reset past sequenced units to OFF.

b. The operator will collect required samples (refer to paragraph 6.6.4.4) at start of shift and immediately submit to laboratory chemist.

c. The operator will record the results of analysis in both the permanent bound log and the laboratory log.

d. The operator will make appropriate entries in equipment logs for the following equipment on each shift:

1. Sewage lift compressors C2 and C3
2. Blowers B1 and B2
3. Water pump P4
4. Froth spray pumps P5 and P6
5. Comminutor C1
6. Chlorinator
7. Sludge hopper

e. Record all equipment and operational changes or modifications in the Operators' Log during the day shift.

f. Perform a general visual inspection to ensure proper functioning of:

1. All equipment during day shift
2. All equipment to which access is permitted during other shifts.

NOTE

Any discrepancies or malfunctions shall be reported immediately to the foreman and recorded in the Operators' Log.

6.6.4.3 Routine Operation Procedure (Weekly).

a. Operate the following equipment during out-of-service periods:

1. Froth spray pumps for 4 hours during day shift
2. Compressors for 4 hours during day shift

b. Flush grit bin of waste contents with clean water and dispose of grit as directed by foreman.

6.6.4.4 Sewage Sample Collection and Analysis Schedule. Tables 6-3 and 6-4 show the sewage sample collection and analysis schedules which include frequencies , quantities, sample sources, and specimens to be analyzed.

Table 6-3. Sewage Sample Collection - Building J8-1705

Frequency	Sample Quantity (Liters)	Sample Source
Daily	4	Influent
Daily	4	Effluent
Daily	4	Aeration
Monthly	4	Receiving Stream

NOTE: Since analysis results are intended to reflect actual operating conditions and overall effectiveness of treatment, the foreman will vary sample specimen and increase frequency of collection as plant conditions vary.

Table 6-4. Analysis Schedule-Building J8-1705

Frequency	Analysis	Sample Source
Daily	pH	Influent, Effluent, Aeration
Daily	Chlorine Residuals	Effluent
Twice-Weekly	Dissolved Oxygen	Influent, Effluent, Aeration
Twice-Weekly	Total Solids @ 103° C	Influent, Effluent, Aeration
Twice-Weekly	Settlings	Influent, Effluent, Aeration
Twice-Weekly	Suspended Solids	Influent, Effluent, Aeration
Twice-Weekly	Biochemical Oxygen Demand	Influent, Effluent, Aeration
Twice-Weekly	Sludge Volume Index	
Monthly	Dissolved Oxygen	Receiving Stream
Monthly	Biochemical Oxygen Demand	Receiving Stream
Monthly	Nitrogen	Influent, Effluent, Aeration

NOTE: The analysis will be preformed by a qualified chemist using only representative samples according to the American Public Health Association standard method.

6.6.4.5 Equipment Inspection. The lift station rotating equipment shall be stopped for a period of 4 hours during the day shift (blowers, compressors, and pumps. Then, proceed as follows:

a. Close SOV3 on chlorinator chlorine tank and potable water supply valve SOV4.

b. Open drain valves GV1, 2, 3, 4 (clarifier, aerator, chlorine contact tank, and sludge collector tank).

c. As each tank nears being drained, wash down walls, clean grit bin and sludge hopper with clean water, and perform inspection.

d. After each tank has been washed and inspected and necessary maintenance functions have been performed, close tank drain valves GV1, 2, 3, 4 (step b).

e. Start lift station rotating equipment, all necessary blowers, compressors, and pumps.

f. Open chlorine gas tank valve SOV3 and potable water supply valve SOV4.

g. Make complete visual inspection of system to ensure that all flows are at the proper level and all equipment is functioning properly.

6.6.4.6 Electrical Power Failure Procedure. In the event of an electrical power failure or low voltage condition occurring during any shift, the following procedure will be initiated at the motor control center.

a. Check all circuit breakers and determine if power outage has been caused by a malfunction on the load side of the main circuit breaker or any secondary circuits.

b. If a malfunction is discovered in a secondary circuit and an individual circuit breaker has tripped, attempt to reset the circuit breaker.

c. If the main circuit breaker has tripped, attempt to reset main circuit breaker.

d. If it is determined that the main power supply has failed and the power outage will continue for an extended period of time, emergency power must be supplied by a portable engine-generator set rated at 440 volts, 3 phases, 60 cycles. Connection terminals are provided outside of the motor control center room.

e. Prior to transfer from normal to emergency power supply, check that phase rotation of emergency power supply is the same as normal supply.

NOTE

The maximum demand permitted by the emergency circuit breaker is 60 amperes. If the emergency generator cannot meet this current requirement (is less than 60 amperes) at initial closing of emergency circuit breaker (step g),make certain that the entire plant electrical power load is not applied at one time.

f. Lock OPEN main circuit breaker or normal supply.

g. Unlock and close emergency main circuit breaker (see note step e).

h. When normal electrical power is restored, lock OPEN emergency power main circuit breaker and close normal power supply main circut breaker.

i. Disconnect portable generator and manually restart the froth spray pumps.

j. Inspect all driven equipment for proper operation.

6.6.5 PREVENTIVE MAINTENANCE. Preventive maintenance scheduling will be provided by BSSC Production Control. Preventive maintenance instructions concerning specific tasks will be provided by BSSC Maintenance Engineering. These instructions will provide information concerning periodic inspection and service, cleaning, adjustment, alignment, calibration, and lubrication. Normal maintenance will be performed on a scheduled basis, and corrosion control and painting shall be performed as required.

6.6.5.1 Failure and Malfunction Measures for Uninterrupted Service. Inspection and servicing schedules will be issued to respective foremen, to operators, and to maintenance technicians. Daily, weekly, monthly, quarterly, semi-annual, and annual log books shall be kept in accordance with the item or component requiring inspection or service.

6.6.5.2 Failure or Malfunction Instructions. In the event of an equipment malfunction or failure, the operating personnel will isolate the problem area and complete a temporary repair to ensure uninterrupted service. A permanent repair will be completed at the earliest possible date on the scheduled equipment downtime basis.

6.6.5.3 Storage. Chemicals, recorder charts, and any necessary expendable material shall be based on a 30-day available supply for the sewage plant. The material shall be readily available for daily control and pickup.

6.6.5.4 Spare Parts. Spare parts shall be stored in a place and manner so that parts shall be readily available for immediate pickup when an emergency arises.

6.7 PLANT NO. 6

(LC-39 Pad B - Scheduled for July 1966 - Information to be supplied).

VOLUME 5

SECTION VII

AIR CONDITIONING SYSTEMS

NOTE

Information for this section was not available for publication at this time. When this section is available, copies will be forwarded to recipients of this manual.

VOLUME 5

SECTION VIII

HEATING SYSTEMS

NOTE

Information for this section was not available for publication at this time. When this section is available, copies will be forwarded to recipients of this manual.

VOLUME 5

SECTION IX

EMERGENCY HVAC OPERATION PLAN

SECTION IX
EMERGENCY DEHUMIDIFICATION PLAN

9.1 PURPOSE

This section establishes a procedure to ensure the protection of moisture-sensitive equipment during a prolonged power or environmental control system (ECS) failure. This equipment is located in facilities referenced in this document as critical areas.

9.2 GENERAL

When a prolonged power failure occurs and causes subsequent failure of the ECS, emergency dehumidification must be provided for critical areas.

The following three systems of emergency dehumidification are available:

System A: Dehumidification by an absorbent material (calcium chloride).
System B: Dehumidification by an adsorbent material (silica-gel).
System C: Dehumidification by portable electrical refrigerant-cycle dehumidifiers.

At present there are approximately 4 thousand pounds of absorbent (calcium chloride) and 4 thousand pounds of adsorbent (silica-gel) available. This material is stored at the Range Storage Warehouse building, south of the Central Supply Warehouse (Building No. M6-744) in an area designated "Hurricane Storage Area." Six portable electrical refrigerant-cycle dehumidifiers are presently available (with six more on order) for use in critical areas where proper auxiliary power is available.

Since the following procedures are concerned with dehumidification during a prolonged power or ECS failure, it is necessary to base considerations, calculations, and conclusions on a condition of static dehumidification, whereby the air contained within the space to be treated shall be considered as still air (subject to minimum degrees of infiltration) at a constant temperature. A quantity of desiccant material shall be used which shall be replaced periodically, after being saturated with moisture for the conditions to be maintained.

9.3 DESCRIPTION AND DEFINITIONS

The following paragraphs present a brief description of the two chemical methods of emergency dehumidification and a discussion of the operation of the portable electrical refrigerant-cycle dehumidifiers.

9.3.1 CALCIUM CHLORIDE ABSORBENT. A solid sorbent material which changes either physically or chemically (or both) during the sorption process. When water is absorbed, the calcium chloride is converted into a hydrate and reaches the saturation point as $CaCl_2 \cdot 2H_2O$, after which additional moisture tends to cause the material to lose its crystalline shape and dissolve. With additional water there is a phase change from solid liquid.

9.3.2 SILICA-GEL ADSORBENT. A solid sorbent material which does not change physically or chemically during the sorption process. At no time is there a phase change or solution of an adsorbent. The action of adsorbents, most of which adsorb some gases and condensible vapors besides water vapor, is selective with the adsorbent material. The adsorbent silica-gel will select to adsorb water vapor in preference to organic vapors. Because of its large equilibrium capacity at high relative humidity, silica-gel is a high-capacity desiccant.

The process of adsorption by solid desiccants, such as silica-gel, is reversible; thus, upon the application of heat in the range of 245° to 260° F, desorption takes place. Since no physical or chemical change occurs to the adsorbent in either process, it is again ready to extract water from a wet gas after reactivation. It is this property of reversibility that makes adsorption an economical process. Silica-gel as an adsorbent is capable of thousands of adsorption-reactivation cycles.

9.3.3 PORTABLE REFRIGERANT-CYCLE DEHUMIDIFIERS. Dehumidification by portable electrically-powered dehumidifiers is accomplished by means of a conventional refrigeration cycle, whereby air is drawn into the dehumidifier and cooled below the ambient dew point temperature, resulting in condensation of water vapor. This air then passes through the refrigerant condenser where it is reheated and released. The portable electric dehumidifiers will provide an expedient and economical method of emergency humidity control in critical areas and will minimize the probability of spacecraft schedule interruption.

9.4 PROCEDURES

To implement Emergency Dehumidification Plan for critical areas, the following procedures should be initiated as soon as possible following power or ECS failure.

9.4.1 PROCEDURE FOR USING CALCIUM CHLORIDE. This procedure covers the use of calcium chloride for emergency dehumidification.

NOTE

When using calcium chloride, it shall be confined in special containers with drain pans.

a. Upon notification of prolonged power or ECS failure (or imminent failure), secure and seal the area to be protected.

b. Using plastic sheeting and pressure-sensitive tape, seal all openings such as supply air, return air, exhaust air, fresh air, relief air, windows, and doors. Explore every means to achieve an airtight atmosphere without disturbing the balancing dampers.

c. Refer to Table 9-1 and determine the quantity of calcium chloride required.

d. Place the calcium chloride within the sealed area.

e. Observe and record the dry bulb and wet bulb temperatures.

f. Monitor the space every 4 hours. Observe and record the dry bulb and wet bulb temperatures. Replenish calcium chloride as required.

9.4.2 PROCEDURE FOR USING SILICA-GEL. This procedure covers the use of silica-gel for emergency dehumidification.

NOTE

When using silica-gel, observe the drum seal. If it is intact (indicating no prior use), proceed with the operation. If the seal is broken, the silica-gel must be reactivated (by baking) according to the manufacturer's instructions. The cafeteria bake-ovens or the oven in Building M7-504 may be used for the reactivation.

a. Upon notification of prolonged power or ECS failure (or imminent failure), secure and seal the area to be protected as outlined in paragraph 9.4.1,b.

b. Refer to Table 9-1 and determine the quantity of silica-gel required.

c. Place the silica-gel within the sealed area in a manner to afford optimum use of the material. The silica-gel is packaged in 16-unit (2-pound) sacks packed 150 to the barrel.

d. Observe and record the dry bulb and wet bulb temperatures.

e. Monitor the space every 4 hours. Observe and record the dry bulb and wet bulb temperatures. Replenish the silica-gel as required.

9.4.3 PROCEDURE FOR USING PORTABLE ELECTRIC DEHUMIDIFIER. This procedure covers the use of portable electric refrigerant-cycle dehumidifiers for emergency dehumidification.

a. Upon notification of a prolonged power or ECS failure (or imminent failure), secure and seal the area to be protected as outlined in paragraph 9.4.1, b.

b. Refer to Table 9-1 and determine the number of portable electric dehumidifiers required.

c. Place the portable electric dehumidifiers within the sealed area. Connect them to a compatible power source and place dehumidifiers in operation according to the manufacturer's instructions.

d. Observe and record the dry bulb and wet bulb temperatures.

e. Monitor the space every 4 hours. Observe and record the dry bulb and wet bulb temperatures to ascertain that the dehumidifiers are operating properly.

9.5 CALCULATIONS

The following paragraphs delineate the calculations used in computing the figures presented in Table 9-1.

a. Space conditions for the critical area shall be assumed as static with a constant temperature of 80° Fahrenheit Dry Bulb (FDB), 90 percent Relative Humidity (RH).

b. The moisture content of the space to be treated shall be reduced to 50 percent RH at approximately 80° FDB.

c. To determine the quantities of desiccant, or number of portable dehumidifiers required, the following method was used.

80° FDB at 90 percent RH =	.020	pounds moisture per pound of air.
80° FDB at 50 percent RH =	.011	pounds moisture per pound of air.
Difference =	.009	pounds of moisture per pound of air. (moisture to be removed)

The volume of air at 80° FDB and 90 percent RH is equal to 14.0 cubic feet per pound of air. The volume of air at 80° FDB and 50 percent RH is equal to 13.8 cubic feet per pound of air. The average volume of air shall be considered to be 14.0 cubic feet

per pound of air. To relate pounds of air to a unit of 1000 cubic feet:

$$\frac{1000 \text{ cu ft}}{14 \text{ cu ft/lb}} = 71 \text{ lb air/1000 cu ft air}$$

To relate pounds of moisture to a unit of 1000 cubic feet:

.009 pounds of moisture to be removed per each pound of air times 71 pounds of air per 1000 cubic feet is equal to 0.639 pounds of moisture to be removed (absorbed, adsorbed, or rejected) from each 1000 cubic feet of static air.

Each pound of calcium chloride will absorb approximately .33 pounds of moisture at 80° FDB and 80 percent RH in about 2 hours to saturation. Each pound of silica-gel will adsorb approximately .04 pounds of moisture to equilibrium. Thus, it will require approximately 2 pounds of calcium chloride absorbent per each 1000 cubic feet of space or approximately 1-1/2 pounds of silica-gel per each 1000 cubic feet of space.

One 2-horsepower portable electric dehumidifier will remove approximately 4.8 pints of water per hour at 80° FDB and at a desired relative humidity of 50 percent.

9.6 PROCEDURE FOR OPERATION OF ELECTRIC DEHUMIDIFIER AS AUXILIARY (SUPPLEMENTAL) UNIT

The portable electric dehumidifiers may also be used to service critical areas in the event one or more of the following failures occur:

1. One or more refrigeration units inoperative
2. One or more cooling tower fans inoperative
3. One or more condenser fans inoperative
4. Cooling tower or condenser inoperative
5. Electric heat failure
6. Refrigeration failure
7. Control failure
8. Scheduled or unscheduled shutdown
9. HTW failure
10. Loss of boiler
11. Pump failure

This list does not constitute all failures that may occur, only the most probable. During any of the above failures the comfort air conditioning may be curtailed, thereby allowing the reduced refrigeration units and portable dehumidifiers to service the critical areas.

Table 9-1. Data Schedule for Critical Areas

Facility: Launch Control Center
Building No. K6-900 Area: LC-39

Critical Area Designation	Volume Thousands of Cubic Feet	Lbs of Moisture to be Removed	Lbs of Absorbent Required (Calcium Chloride)	Lbs of Adsorbent Required (Silica-Gel)	Number of Portable Electric Dehumidifiers Required
Room 1P-1 1P-2	38.4	24.5	77	58	
Room 1P-3	18.0	11.5	36	27	1
Room 1P-9	42.3	27.0	84	63	2
Room 2P-20	19.8	12.6	39	30	1
Room 2P-22	9.7	6.2	19	15	1
Room 2P-19	9.9	6.3	20	15 v	1
Room 2P-25	11.2	7.2	22	17	1
Room 2P-17	20.0	12.8	40	30	1
Room 2P-12	5.6	3.6	11	8	1
Room 2016	7.3	4.7	14	10	1
Room 2P-10	29.5	18.9	59	44	2
Room 2R-1	9.4	6.0	18	14	1

Table 9-1. Data Schedule for Critical Areas (Continued)

Facility: Launch Control Center
Building No. K6-900 Area: LC-39

Critical Area Designation	Volume Thousands of Cubic Feet	Lbs of Moisture to be Removed	Lbs of Absorbent Required (Calcium Chloride)	Lbs of Adsorbent Required (Silica-Gel)	Number of Portable Electric Dehumidifiers Required
Firing Room No. 1	277.1	177.1	554	416	
Room 3P-15	13.0	4.3	26	20	1
Room 3P-16	5.2	3.2	10	8	1
Room 3P-13	3.9	2.5	8	6	1
Firing Room No. 2	277.1	177.0	544	416	
Room 3002 C	13.4	8.6	27	20	1
Firing Room No. 3	277.1	177.0	544	416	
Room 3103 E	13.0	8.3	26	20	1
Room 3103 B	3.9	2.5	8	6	1
Room 3103 A	4.2	2.7	8	6	1
Room 3R-13	7.1	4.5	14	11	1
Room 3R-18	14.2	9.1	30	21	1
Firing Room No. 4	277.1	177.0	544	416	

Table 9-1. Data Schedule for Critical Areas (Continued)

Facility: Instrumentation Facility
Building No. K7-1557 Area: LC-39

Critical Area Designation	Volume Thousands of Cubic Feet	Lbs of Moisture to be Removed	Lbs of Absorbent Required (Calcium Chloride)	Lbs of Adsorbent Required (Silica-Gel)	Number of Portable Electric Dehumidifiers Required
Instrumentation	16.3	10.4	33	24	1
Shop	4.4	2.8	9	7	1
Storage	1.6	1.0	3	2	1

Note: This facility has auxiliary power available to operate one air-conditioning unit.

Table 9-1. Data Schedule for Critical Areas (Continued)

Facility: VAB Repeater Building.
Building No. K6-1193 Area: LC-39

Critical Area Designation	Volume Thousands of Cubic Feet	Lbs of Moisture to be Removed	Lbs of Absorbent Required (Calcium Chloride)	Lbs of Adsorbent Required (Silica-Gel)	Number of Portable Electric Dehumidifiers Required
Cable Terminal	49.4	31.6	99	74	2

Table 9-1. Data Schedule for Critical Areas (Continued)

Facility: Manned Spacecraft Operations Building
Building No. M7-355 Area: IND

Critical Area Designation	Volume Thousands of Cubic Feet	Lbs of Moisture to be Removed	Lbs of Absorbent Required (Calcium Chloride)	Lbs of Adsorbent Required (Silica-Gel)	Number of Portable Electric Dehumidifiers Required
Room 2446	19.6	12.5	39	29	2
Room 2456	8.1	5.2	16	12	1
Room 2468	1.3	0.8	3	2	1
Room 3406	7.2	4.6	14	11	1
Room 3416	8.6	5.5	17	13	1
Room 3430	13.0	8.3	26	20	1
Room 3436	9.4	6.0	19	14	1
Room 3420	3.6	2.3	7	5	1
Room 3424	13.0	8.3	26	20	1
Room 3446	13.0	8.3	26	20	1
Room 3412	8.7	5.6	17	13	1
Room 3410	7.2	4.6	14	11	1

Table 9-1. Data Schedule for Critical Areas (Continued)

Facility: Manned Spacecraft Operations Building
Building No. M7-355 Area: IND

Critical Area Designation	Volume Thousands of Cubic Feet	Lbs of Moisture to be Removed	Lbs of Absorbent Required (Calcium Chloride)	Lbs of Adsorbent Required (Silica-Gel)	Number of Portable Electric Dehumidifiers Required
Room 3440	13.0	8.3	26	20	1
Room 3450	5.3	3.4	11	8	1
Room 4422	13.7	8.8	27	21	1
Room 4432	13.7	8.8	27	21	1
Room 4442	13.7	8.8	27	21	1
Room 4452	13.7	8.8	27	21	1
Room 4456	7.2	4.6	14	11	1
Room 4458	5.0	3.2	10	8	1
Room 4462	17.2	10.9	34	26	1
Room 4468	8.6	5.5	17	13	1
Room 4438	1.2	0.8	2	2	1
Room 4472	8.6	5.5	17	13	1
Room 4432	13.7	8.8	27	21	1

Table 9-1. Data Schedule for Critical Areas (Continued)

Facility: Central Instrumentation Facility
Building No. M6-342 Area: IND

Critical Area Designation	Volume Thousands of Cubic Feet	Lbs of Moisture to be Removed	Lbs of Absorbent Required (Calcium Chloride)	Lbs of Adsorbent Required (Silica-Gel)	Number of Portable Electric Dehumidifiers Required
Room 156	6.7	4.3	13	10	1
Room 170	11.7	7.5	23	18	1
Room 173	17.9	11.4	36	27	1
Room 177	17.9	11.4	36	27	1
Room 205	46.0	29.4	92	69	2
Room 209	10.8	6.9	22	16	1
Room 231	13.5	8.6	27	20	1
Room 248	6.1	3.9	12	9	1
Room 250	2.6	1.7	5	4	1
Room 255 291A	3.7	2.4	7	6	1
Room 276	6.7	4.3	13	10	1
Room 282	8.3	5.3	17	12	1

Table 9-1. Data Schedule for Critical Areas (Continued)

Facility: Central Instrumentation Facility
Building No. M6-342 Area: IND

Critical Area Designation	Volume Thousands of Cubic Feet	Lbs of Moisture to be Removed	Lbs of Absorbent Required (Calcium Chloride)	Lbs of Adsorbent Required (Silica-Gel)	Number of Portable Electric Dehumidifiers Required
Room 291	44.0	28.1	88	66	2
Room 294	7.3	4.7	15	10	1
Room 297	23.5	15.0	47	35	2
Room 307	34.0	21.7	68	51	2
Room 313	4.8	3.1	10	7	1
Room 323	5.6	3.6	11	8	1
Room 325	6.3	4.0	13	10	1
Room 327	13.6	98.7	27	20	1
Room 347	5.2	3.3	10	8	1
Room 351	6.8	4.3	14	10	1
Room 387	7.6	4.9	15	11	1

Table 9-1. Data Schedule for Critical Areas (Continued)

Facility: Central Instrumentation Facility Annex
Building No. L7-1557 Area: IND

Critical Area Designation	Volume Thousands of Cubic Feet	Lbs of Moisture to be Removed	Lbs of Absorbent Required (Calcium Chloride)	Lbs of Adsorbent Required (Silica-Gel)	Number of Portable Electric Dehumidifiers Required
Instr Room 14	28.8	18.4	58	43	2
Telemetry Room 2	4.4	2.8	9	7	1
Tel equip Room 1	4.4	2.8	9	7	1
Lab Room 1	5.7	3.6	11	9	1
Operational Supplies	0.7	0.4	1	1	1
RF Shielded Room 1	1.1	0.7	2	2	1
RF Shield Room 2	1.1	0.7	2	2	1
RF & Data Forms Room 8	1.4	0.9	3	2	1

Table 9-1. Data Schedule for Critical Areas (Continued)

Facility: Communications Distribution and Switching Center
Building No. M6-138 Area: IND

Critical Area Designation	Volume Thousands of Cubic Feet	Lbs of Moisture to be Removed	Lbs of Absorbent Required (Calcium Chloride)	Lbs of Adsorbent Required (Silica-Gel)	Number of Portable Electric Dehumidifiers Required
Wideband Room	22.1	14.1	44	33	2
Switching Equip	63.5	40.6	127	95	--
Main Flame	20.3	13.0	41	30	1
Carrier	18.0	11.5	36	27	1

Table 9-1. Data Schedule for Critical Areas (Continued)

Facility: Central Telemetry Tel IV
Building No. N6-2296 Area: IND

Critical Area Designation	Volume Thousands of Cubic Feet	Lbs of Moisture to be Removed	Lbs of Absorbent Required (Calcium Chloride)	Lbs of Adsorbent Required (Silica-Gel)	Number of Portable Electric Dehumidifiers Required
1st Fl Instr	109.2	69.8	218	164	
2nd Fl Control Room	6.5	4.2	13	10	1
2nd Fl N Display	21.4	13.7	43	32	2
2nd Fl S Display	28.8	18.4	58	43	2

Table 9-1. Data Schedule for Critical Areas (Continued)

Facility: Parachute
Building No. M7-657 Area: IND

Critical Area Designation	Volume Thousands of Cubic Feet	Lbs of Moisture to be Removed	Lbs of Absorbent Required (Calcium Chloride)	Lbs of Adsorbent Required (Silica-Gel)	Number of Portable Electric Dehumidifiers Required
Room 103	8.9	5.6	17	13	1
Room 104	5.5	3.5	11	8	1

Table 9-1. Data Schedule for Critical Areas (Continued)

Facility: Spacecraft Supply and Equipment
Building No. M7-505 Area: IND

Critical Area Designation	Volume Thousands of Cubic Feet	Lbs of Moisture to be Removed	Lbs of Absorbent Required (Calcium Chloride)	Lbs of Adsorbent Required (Silica-Gel)	Number of Portable Electric Dehumidifiers Required
Room 201	24.6	15.7	49	37	2

Table 9-1. Data Schedule for Critical Areas (Continued)

Facility: NAA Warehouse
Building No. Between M7-504 and M7-505 Area: IND

Critical Area Designation	Volume Thousands of Cubic Feet	Lbs of Moisture to be Removed	Lbs of Absorbent Required (Calcium Chloride)	Lbs of Adsorbent Required (Silica-Gel)	Number of Portable Electric Dehumidifiers Required
Spare Parts Room	54.0	34.5	108	8.1	2

SECTION X
OPERATIONS AND MAINTENANCE PROCEDURE FOR COMPRESSED AIR SYSTEMS

10.1 PURPOSE

This section defines the operations and maintenance procedures for compressed air systems and establishes the areas of Base Operations Divisions (BOD) responsibility for these operations and maintenance.

10.2 GENERAL

BOD has the responsibility for the operations and maintenance of the compressed air systems in Launch Complex 39, Spacecraft Checkout Areas, and the Industrial Area of KSC.

10.2.1 OPERATIONS. The compressed air systems are designed for automatic and unmanned operations. The design also includes provisions for manual override of the control system for use during regularly scheduled maintenance periods, service outages as a result of equipment malfunction, or emergencies.

10.2.2 MAINTENANCE. The periodic maintenance of equipment will be scheduled by Production Control. The maintenance personnel will maintain the equipment in accordance with the preventive maintenance instructions and procedures.

10.2.3 EMERGENCY. An emergency is considered to exist at any time the compressed air system will not perform its function because of unexpected circumstances. Any such emergency shall be evaluated by the cognizant foreman who will determine the cause of the outage and if auxiliary equipment is required. An emergency resulting from a power outage shall be relieved in accordance with the Emergency Power Systems Procedure and Emergency Generator Requirement Procedure.

10.2.4 OPERATOR RESPONSIBILITIES. The operator shall be familiar with the manufacturers' equipment manual and know the function of the equipment and its accesories. The operator shall maintain the Daily Log Sheet and report immediately to his foreman any malfunction of the equipment.

10.2.5 MAINTENANCE AND OPERATING PROCEDURES. The specific instructions for each system shall be kept as pertinent documents of the respective building or area. In addition to specific instructions, the maintenance and operating procedure for each system shall include the following:

a. Equipment manual
b. Equipment record card
c. Preventive maintenance card
d. Preventive maintenance manual
e. Lubrication specifications and procedure
f. Paint specification and procedure
g. Emergency power systems procedure
h. Emergency generator requirements procedure.

10.3 LAUNCH COMPLEX 39

10.3.1 UTILITY ANNEX K6-947. The Utility Annex Plant is equipped with two compressed air systems.

a. The plant service air system consists of two 1500-cfm compressors, two aftercoolers with moisture separators, two receivers, and related plumbing to include a 6-inch air line from the primary air receiver across the utility bridge to tower A of the Vehicle Assembly Building (VAB).

b. The start air system for the emergency power diesel engines consist of a 15-cfm compressor, a moisture separator, two air receivers, and related plumbing.

10.3.1.1 Plant Service Air System. The step-by-step procedure for routine starting of the plant service air system is as follows:

a. Place the high voltage switch in the CLOSED position.
b. Place the dc generator disconnect switch in the motor control center to the ON position.
c. Check the cooling water system for proper water flow.
d. Open the cooling water line to intercooler bypass valve to the half-opened position.
e. Open the air receiver valve.
f. Close the idle compressor discharge valve.
g. Open the air inlet and outlet valves at the aftercooler.
h. Turn the hand-operated unloaders and manually unload the compressor.
i. Place the unload switch located on the panel in the OFF position.
j. Manually operate each oil feeder on the side of the compressor.
k. Manually pump the oil pressure to 15 to 20 psi and press the start button.
l. Check that the speed of the machine is within operating range and the oil pressure builds up to 50 psi.
m. Turn the manual unloaders to the automatic position.
n. Place the unload switch located on the panel in the ON position.
o. Check that intercooler water outlet temperature ranges between 100° and 120° F.
p. Check that the field excitation meter on the dc panel reads between 25 and 29 amperes.

10.3.1.2 Start Air System. The step-by-step procedure for routine starting of the start air system for the emergency power diesel engines is as follows:

a. Check the oil level in the compressor.
b. Turn the switch on the electrical panel to the ON position.
c. Check for proper air pressure buildup.
d. Open the drain cock and drain the water from the moisture separator.
e. Check for proper operation of the compressor and that the air pressure is maintained at 250 psi.

10.3.2 VEHICLE ASSEMBLY BUILDING K6-848. The VAB is supplied compressed air from the Utility Annex. However, the VAB has a distribution system with eight air dryers located two each in towers B, C, D, and E.

Each dryer has a capacity to dry 200 cfm 95°F saturated air to 35°F dewpoint. The dryer is a self-contained unit of the refrigerated type and includes a heat exchanger, refrigerant compressor, automatic controls, and a moisture trap.

The heat exchanger includes air and refrigerant coils surrounded by a heat conducting medium. The moisture separator is of the centrifuge type and removes free moisture and oil from the air.

10.3.3 PAD SEWAGE TREATMENT PLANT COMPRESSED AIR SYSTEM. The compressed air systems of the sewage treatment plants at pads A and B are identical and for the purposes of this procedure will be defined only once. The plants are provided with sewage aeration systems and sewage ejector air systems.

Compressed air for the aeration system is provided by two electric motor-driven rotary compressors.

Compressed air for the ejector system is provided by electric motor-driven compressors. Emergency standby power is provided for one of these compressors by means of a self-contained gasoline engine.

10.3.3.1 Routine Starting Instructions. The routine starting instructions apply to both the ejector and aerating systems as follows:

a. Check the oil level in the compressor.
b. Open the discharge valve.
c. Turn start switch to AUTO.
d. Observe the compressor for proper operation.

10.3.4 LAUNCH EQUIPMENT SHOP M6-1247. The Launch Equipment Shop compressed air system consists of a 185-cfm water-cooled compressor, a chilled-water aftercooler, an air dryer, a 250-gallon receiver, and related plumbing.

10.3.4.1 Routine Starting Instructions. The routine starting instructions for the Launch Equipment Shop compressed air system are as follows:

a. Check the oil level in the compressor.
b. Check that the air valves are open to the aftercooler and receiver.
c. Check that water valves are open to the aftercooler.
d. Turn the start switch on the electrical panel in the equipment room to AUTO.
e. Observe the compressor for proper operation.
f. Check the air dryer for proper operation.

10.3.5 RECEIVING, INSPECTION, AND TEST LABORATORY BUILDING K7-506. (Maintenance Responsibility Only) The Receiving, Inspection, and Test Laboratory Building compressed air system consists of an air compressor, aftercooler, receiver, controls, and related plumbing.

10.3.6 CENTRAL INSTRUMENTATION FACILITY M6-342. The Central Instrumentation Facility compressed air system consists of two 65-cfm compressors, two chilled-water aftercoolers, two 19-cubic feet receivers, and related plumbing.

10.3.6.1 Routine Starting Instructions. The routine starting instructions for the Central Instrumentation Facility compressed air system are as follows:

a. Turn the compressor operating switch to OFF.
b. Turn on the power supply.
c. Open the main line discharge valve.
d. Open the compressor control line valve.
e. Check the water supply for flow and pressure.
f. Select the mode of operation (hand or automatic).
g. Check that oil pressure is 35 psi.
h. Check that water flows through the unit.
i. Check for terminal pressure rise and that the compressor unloads at the correct pressure.
j. Check the discharge water temperature (about 110° F).
k. Check operation of solenoid-controlled water valve. The valve should shut off when the compressor unloads in the auto mode and the unit will shut down. The valve should remain open, and the water should continue to flow when the compressor unloads in the hand mode.

10.3.7 INFORMATION SYSTEMS OPERATION L7-1557. The Information Systems Operation compressed air system consists of two 29-cfm air compressors, two aftercoolers, two air dryers, two receivers, controls, and related plumbing.

10.3.7.1 Routine Starting Instructions. The routine starting instructions for the Information Systems Operation compressed air system are as follows:

a. Check the oil level in the compressor.
b. Turn the switch on the panel to ON.
c. Observe that the oil pressure comes up to operating range.
d. Open the receiver valve.
e. Check that proper pressure is maintained.
f. Check the operation of the dryer.

10.3.8 AIR DRYER UNITS FOR CABLE SYSTEMS. (Maintenance Responsibility Only) Air dryer units are strategically located to provide dry air for the cable systems used in communication, television, and data link transmission.

The air dryer units consist of an air compressor, refrigeration unit, controls, and related plumbing. Two model units are in use: namely the 1,500 Model with a 1,500-cubic-foot-per-day capacity and the 5,000 Model with a 5,000-cubic-foot-per-day capacity. Units are installed in locations as follows:

a. Launch Control Center K6-900 Two 5,000 Models
b. VAB Repeater K6-1193 Two 1,500 Models
c. Pad 39A Two 1,500 Models
d. DLRT K7-89 One 5,000 Model
e. DLRT K7-422 One 5,000 Model
f. Communications Distribution and Switching Center M6-138 Two 1,500 Models.
g. South Repeater Station N6-1118 Two 1,500 Models
h. Wilson House One 1,500 Model
i. Tip Shack One 1,500 Model

10.4 SPACECRAFT CHECKOUT AREAS

10.4.1 MANNED SPACECRAFT OPERATIONS BUILDING M7-355. The Manned Spacecraft Operations Building compressed air system consists of two 120-cfm compressors, two aftercoolers, a receiver, and related plumbing.

10.4.1.1 Routine Starting Instructions. The routine starting instructions for the Manned Spacecraft Operations Building compressed air system are as follows:

a. Check the oil level in the air compressor.
b. Open the air discharge valve.
c. Turn the switch on the electrical panel to ON.
d. Observe that the oil pressure reaches 30 psi.

e. Check that the air valves at the aftercooler are open.
f. Check that both inlet and outlet water valves on the aftercooler are open.
g. Open the drain valves on the traps.

10.4.2 LIFE SUPPORT TEST BUILDING M7-961. The Life Support Test Building compressed air system consists of a 6.7-cfm compressor, a 30-gallon receiver, controls, and related plumbing.

10.4.2.1 Routine Starting Instructions. The routine starting instructions for the Life Support Test Building compressed air system are as follows:

a. Check the oil level in the air compressor.
b. Turn the starter switch to AUTO.
c. Open the air discharge valve at the receiver.
d. Drain the water from the separator.

10.4.3 HYPERGOLIC BUILDING NO. 1. The Hypergolic Building No. 1 compressed air system consists of a 6.7-cfm compressor, a 30-gallon receiver, controls, and related plumbing.

10.4.3.1 Routine Starting Instructions. The routine starting instructions for the Hypergolic Building No. 1 compressed air system are as follows:

a. Check the oil level in the air compressor.
b. Turn the starter switch to AUTO.
c. Open the air discharge valve at the receiver.
d. Drain the water from the separator.

10.4.4 CRYOGENIC BUILDING NO. 1. The Cryogenic Building No. 1 compressed air system consists of a 6.7-cfm compressor, a 30-gallon receiver, controls, and related plumbing.

10.4.4.1 Routine Starting Instructions. The routine starting instructions for the Cryogenic Building No. 1 compressed air system are as follows:

a. Check the oil level in the air compressor.
b. Turn the starter switch to AUTO.
c. Open the air discharge valve at the receiver.
d. Drain the water from the separator.

10.4.5 HYPERGOLIC BUILDING NO. 2, M7-1210. The Hypergolic Building No. 2 compressed air system consists of an air compressor, a receiver, an aftercooler, controls, and related plumbing.

10.4.5.1 Routine Starting Instructions. The routine starting instructions for the Hypergolic Building No. 2 compressed air system are as follows:

a. Check the oil level in the air compressor.
b. Turn the switch to ON.
c. Check for water flow through the aftercooler.
d. Check that air pressure is 100 psi.

10.4.6 CRYOGENIC BUILDING NO. 2, M7-1410. The Cryogenic Building No.2 is equipped with two compressed air systems; namely, a plant service air system and a door sealer system. Each system consists of a compressor, receiver, aftercooler, controls, and related plumbing.

10.4.6.1 Routine Starting Instructions for Plant Service Air System. The routine starting instructions for the plant service air system are as follows:

a. Check the oil level in the compressor.
b. Turn the switch to ON.
c. Observe that the oil pressure reaches 30 psi.
d. Check for air pressure buildup.
e. Check that the water valves to the aftercooler are open.
f. Open the valves from the automatic water traps.

10.4.6.2 Routine Starting Instructions for the Door Sealer Air System. The routine starting instructions for the door sealer compressed air system are as follows:

a. Check the oil level in the compressor.
b. Turn the switch on the electrical panel to ON.
c. Check for water flow through the aftercooler.
d. Check for air pressure buildup.

10.4.7 PYROTECHNIC INSTALLATION M7-1469. The Pyrotechnic Installation compressed air system consists of a 175-cfm, two-stage compressor, an intercooler, aftercooler, receiver, prefilter, dryer, pressure reducing valve,and related plumbing.

10.4.7.1 Routine Starting Instructions. The routine starting instructions for the Pyrotechnic Installation compressed air system are as follows:

a. Check the oil level in the compressor.
b. Turn the switch on the electrical panel to ON.
c. Check that oil pressure reaches an acceptable operating level.
d. Check that the air valve to the receiver is open.

e. Check that the air valves to and from the aftercooler are open.
f. Check that the water valves are open to and from the aftercooler.
g. Check that the drain valves at the traps are open.
h. Check that one tank on the dryer has full air pressure.

10.4.8 PARACHUTE BUILDING M7-657. The Parachute Building plant air system consists of a 35-cfm compressor, an aftercooler, an 80-gallon receiver, a two-chamber heatless desiccant dryer, filters, and related plumbing.

10.4.8.1 Routine Starting Instructions. The routine starting instructions for the Parachute Building compressed air system are as follows:

a. Check the oil level in the compressor.
b. Open the water valve to the aftercooler.
c. Turn the switch on the panel to ON.
d. Open the receiver discharge valve.
e. Open the air valves to and from the dryer.
f. Check that one chamber on the dryer has full air pressure.

10.4.9 FLIGHT CREW TRAINING BUILDING M7-409. The Flight Crew Training Building compressed air system consists of an air compressor, aftercooler, receiver, and related plumbing.

10.4.9.1 Routine Starting Instructions. The routine starting instructions for the Flight Crew Training Building compressed air system are as follows:

a. Check the oil level in the compressor.
b. Open the air discharge valve from the compressor.
c. Open the water valve to the aftercooler.
d. Turn the switch on the panel to ON.
e. Check that the air pressure in the receiver comes up to operating pressure.

10.4.10 ORDNANCE STORAGE M7-1472. The Ordnance Storage compressed air system consists of an air compressor, receiver, controls, and related plumbing.

10.4.10.1 Routine Starting Instructions. The routine starting instructions for the Ordnance Storage compressed air system are as follows:

a. Check the oil level in the compressor.
b. Turn the switch on the panel to ON.
c. Open the receiver air valve.

10.4.11 ORDNANCE FIELD TEST LABORATORY M7-1417. The Ordnance Field Test Laboratory compressed air system consists of two 10-cfm air compressors, aftercoolers, separator, traps, a 145-gallon receiver, a refrigeration-type dryer, and related plumbing.

10.4.11.1 Routine Starting Instructions. The routine starting instructions for the Ordnance Field Test Laboratory compressed air system are as follows:

a. Check the oil level in the compressors.
b. Open the air compressor air discharge valves.
c. Turn the switches on the electrical panels of both compressors to ON.
d. Open the air valves to the aftercooler.
e. Open the water valves to the aftercooler.
f. Open the air valves to the separators.
g. Open the air valves to the traps.
h. Open the drain valves weekly.

10.4.12 SPACECRAFT SPARES AND EQUIPMENT BUILDING M7-505. (West) The Spacecraft Spares and Equipment Building compressed air system consists of a compressor, an aftercooler, receiver, controls, and related plumbing.

10.4.12.1 Routine Starting Instructions. The routine starting instructions for the Spacecraft Spares and Equipment Building compressed air system are as follows:

a. Check the oil level in the compressor.
b. Turn switch on electrical box to HAND operation.
c. Open water valve to aftercooler.

10.4.13 SPACECRAFT SPARES AND EQUIPMENT BUILDING M7-505. (East) The Spacecraft Spares and Equipment Building compressed air system consists of a 40-cfm compressor, aftercooler, an 80-gallon receiver, dryer, controls, and related plumbing.

10.4.13.1 Routine Starting Instructions. The routine starting instructions for the Spacecraft Spares Equipment Building compressed air system are as follows:

a. Check the oil level in the compressor.
b. Turn the switch on the panel to ON.
c. Open the air valves at the aftercooler.
d. Open the water valves at the aftercooler.
e. Open the air valves at the dryer and close the bypass valve.

10.5 INDUSTRIAL AREA

10.5.1 KENNEDY SPACE CENTER M6-399. The KSC M6-399 is equipped with two compressed air systems. One system provides air at 20 psi and the other system provides air at 80 psi. Each system consists of a compressor, 227 cfm for 25-psi system and 72.5 cfm for the 80-psi system, an aftercooler, receiver, automatic water traps, and related plumbing.

10.5.1.1 Routine Starting Instructions. The routine starting instructions for the KSC M6-399 apply to both the 25-psi and 80-psi systems as follows:

a. Turn the compressor switch the electrical box to OFF.
b. Turn on power supply.
c. Open the discharge air valve.
d. Open the compressor control line air valve.
e. Check the water supply for proper flow.
f. Select mode of operation (hand or automatic).
g. Check that the oil pressure is 35 psi.
h. Observe for proper water flow through the unit.
i. Check for rise in terminal pressure and that the system unloads at specified pressure.
j. Check that the discharge water temperature is maintained at 110°F.
k. Check operation of solenoid controlled water valve. The valve should shut off when the compressor unloads in the auto mode, and the unit will shut down. The valve should remain open, and the water should continue to flow when the compressor unloads in the hand mode.

10.5.2 PLANT MAINTENANCE BUILDING M6-486. The Plant Maintenance Building compressed air system consists of a 40-cfm compressor, an 80-gallon receiver, aftercooler, controls, and related plumbing.

10.5.2.1 Routine Starting Instructions. The routine starting instructions for the Plant Maintenance Building compressed air system are as follows:

a. Check the oil level in the compressor.
b. Open the water valve and check for proper water flow through the aftercooler.
c. Turn on the main switch number 15.
d. Open the receiver discharge air valve.
e. Check that proper pressure is maintained in the receiver.

10.5.3 HEAT PLANT M6-595. The Heat Plant compressed air system consists of two 67-cfm compressors, two aftercoolers, an air receiver, a 30-cfm air dryer with receiver, an automatic drain, controls, and related plumbing.

10.5.3.1 Routine Starting Instructions. The routine starting instructions for the Heat Plant compressed air system are as follows:

a. Check the oil level in the compressors.
b. Open the water valves to the compressor and aftercooler.
c. Open the compressor discharge air valve.
d. Turn the unloader switch to the OFF position.
e. Open the drain valve one quarter turn. This valve is located at the low point in the compressor discharge line.
f. Press the start button and hold until oil pressure is observed.
g. Check that the oil pressure is 30 to 35 psi.
h. Turn the unloader switch to ON.
i. Close the drain valve opened in step e.

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SECTION XI

AIR FILTER AND WATER STRAINER CLEANING PROCEDURE

SECTION XI
AIR FILTER AND WATER SEDIMENT STRAINER CLEANING PROCEDURES

11.1 PURPOSE

The purpose of this section is to establish procedures for the effective cleaning of the air filters and water sediment strainers in the Vehicle Assembly Building (VAB), Launch Control Center (LCC), and surrounding facilities in the Launch Complex 39 (LC-39) Area. In addition, instructions are given for cleaning operations for air filters and water sediment strainers in the Kennedy Space Center (KSC) Industrial Area.

11.2 LAUNCH COMPLEX 39

Approximately 1600 permanent cleanable air-conditioning and heating filters are used in the VAB and LCC. In the surrounding LC-39 facilities, there are approximately 150 permanent cleanable filters. These filters are to be washed and oiled on a rotating schedule. Approximately 300 disposable filters are used for dust stops in the VAB Area.

There are approximately 600 water sediment strainers located in water lines at pump suction inlets, heating coils, and control valves in the VAB, LCC, and Utility Annex. These are to be removed and cleaned on location.

11.2.1 FILTER CLEANING MACHINES. Three portable, automatic filter cleaning machines will be located in the LC-39 Area. Two will be in the VAB-LCC area to service approximately 1600 filters and one in the Utility Annex to service approximately 150 filters in the surrounding LC-39 facilities. Each machine is capable of washing, drying, oiling, and preparing for immediate use 50 filters per hour. The machines in the VAB-LCC area are to be moved to a suitable Fan Room for the cleaning operation. One machine in the VAB-LCC area will be considered a spare for the machine which serves the KSC Industrial Area.

11.2.2 SPARE FILTERS. Tentatively and until otherwise dictated by operating techniques and convenience, approximately 200 spare filters shall be stored in area K and area M fan rooms, low bay of the VAB. These will provide a complete change of filters for one or more air-handling units. The spare filters will enable cleaning crews to replace dirty filters when they are to be cleaned. To avoid blowing dirt and dust into the area and into wet cooling coils during the filter change operation, the air-handling unit will be shut down. The shutdown should not exceed 1/2 hour and will be accomplished only after having been coordinated with the area occupants. The use of spare filters will keep the downtime of each unit to a minimum and facilitate the filter cleaning operations.

The following sizes and quantities of spare filters are required to provide a complete change of filters in any air-handling unit:

Size	Quantity
16x25x1	20
20x25x1	20
16x20x2	40
16x25x2	40
20x20x2	40
20x25x2	40

11.2.3 FILTER CARTS. Three filter carrying carts shall be provided, each capable of transporting 40 filters. These carts will reduce the time required to transport clean or dirty filters. Their use avoids the soiling of furnishings and surroundings. The carts are of a dolly type and will be used in the VAB and LCC Buildings. They are designed for easy and safe one-man maneuverability.

11.2.4 EQUIPMENT ROOMS. Facilities must be available in each equipment room to supply the filter cleaning machine with 140° Fahrenheit hot water at an intermediate flow rate of 115 gallons per hour or an average rate of 2 gpm.

The following equipment rooms have a shell and tube heat exchanger to provide 140° Fahrenheit domestic hot water. Capped connections are available, but valves will have to be installed to service the filter cleaning machines. Floor drains suitable for the cleaning operation are available.

Tower	Equipment Room
A	S
B	B, X
D	J, K
E	M&L, N, O, P, Q
F	R

Domestic hot water (140° Fahrenheit) is available from a shell and tube heat exchanger in tower "D," Equipment Room "U." The hot water lines will have to be tapped and connections and valves installed. Floor drains are available for the cleaning operation.

Equipment Room "R" in the LCC Building has 140° Fahrenheit domestic hot water available from a shell and tube heat exchanger. This system serves toilets and showers. The hot water lines will require a connection and valve to service the filter cleaning machines. Suitable floor drains are available.

NOTE

A separate 180° Fahrenheit domestic hot water system is provided to serve the cafeteria dishwashers.

11.2.5 FILTER CLEANING MACHINE OPERATION. To achieve proper operation of the filter cleaning machines, follow the manufacturer's instructions supplied with each machine.

11.2.6 FILTER CLEANING CREW. The filter cleaning crew consists of four Ground Service Helpers, one Lead Ground Service Helper, and an Air-Conditioning Foreman. This crew is under the supervision of the Assistant Superintendent of Base Utilities Air-Conditioning Maintenance and Operations Department. Three trucks are available for the crew.

11.2.7 WATER SEDIMENT STRAINERS. The VAB, LCC, and Utility Annex contain a total of approximately 600 water sediment strainers. The strainers are located at heating coils, control valves, and pump suction inlets in the chilled water and hot water lines.

11.2.8 WATER SEDIMENT STRAINER CLEANING CREW. Cleaning of the water sediment strainers is the responsibility of the utility mechanics of Utility Annex Air-Conditioning Shop, under the supervision of the General Foreman. These men remove, clean, and replace the strainers, then back-flush the associated water lines.

11.2.9 WATER SEDIMENT STRAINER CLEANING OPERATION. The water sediment strainers to be cleaned must be removed from the water line, cleaned with water and a wire brush, then reinstalled. Once the cleaning of the strainer has been accomplished, the associated water lines must be back-flushed to remove any accumulated debris. Initial cleaning of the strainers will be accomplished as the various water systems in the LC-39 area are placed into operation. When all systems have been initially cleared of debris, the strainers will require only an occasional cleaning. The subsequent cleaning operations will be scheduled as a part of the Preventive Maintenance Program.

11.3 KSC INDUSTRIAL AREA

There are approximately 700 permanent cleanable air-conditioning and heating filters in the KSC Industrial Area. They are to be washed and oiled by the same cleaning crew that services the LC-39 Area. Spare filters will be stored in various equipment rooms in the KSC Industrial Area. The portable filter cleaning machine and the spare filters will be transported from building to building for the cleaning operations.

There are approximately 500 water sediment strainers in the KSC Industrial Area, which are to be checked periodically by the air-conditioning mechanics under the supervision of the Assistant Superintendent of Base Utilities Maintenance and Operations Department. If any strainer shows evidence of restricted water flow, it should be removed and cleaned. Approximately 1-1/2 hours are required to remove, clean, and replace each strainer. After cleaning, strainers are serviceable for approximately 6 months.

N67-14898

IMPORTANT NOTICE

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This package contains corrected pages to be inserted in each copy of Volume 5 you have received.

It is requested that this action be taken immediately to ensure proper information is contained in your copies.

Proceed as follows:

(a) Remove and destroy existing pages iii, iv, 1-1, 1-2, and 1-3/4.

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BASE UTILITIES OPERATION AND MAINTENANCE

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VOLUME 5

LIST OF ILLUSTRATIONS

SECTION I

HIGH VOLTAGE POWER DISTRIBUTION

1.1 PURPOSE

To establish operating procedure for the high voltage power distribution system of the Kennedy Space Center Industrial Area and the electrical equipment (voltage higher than 480) at LC-39.

1.2 GENERAL

The high voltage power system shall be operated by Base Operations Division (BOD), as per item 36 of the BOD-LSOD agreement, dated 10-30-64; by the equipment manufacturers' handbook; by the substation operating instructions; and by the system diagrams posted at the primary substation, File No. D0203-23-094, Sheet 168, and NASA-165-L0 20027, Sheets 1 to 8 inclusive.

1.3 DEFINITIONS

a. Operational Interface - the extent of BOD responsibility for operation of switchgear, controls, and similar devices.

b. Maintenance Interface - the extent of BOD responsibility for maintenance of equipment, lines, etc.

1.4 PROCEDURE

1.4.1 HIGH VOLTAGE POWER DISTRIBUTION SYSTEMS KENNEDY SPACE CENTER INDUSTRIAL AREA.

1.4.1.1 Responsibility. It is the responsibility of the Base Support Services Contractor (BSSC) to operate and maintain the high voltage power distribution system in the Kennedy Space Center Industrial Area.

1.4.1.2 Operation. The primary substation will be operated in accordance with Operating Instructions, Electric Substation M6-996 attached hereto.

1.4.1.3 Switching. Switching operations outside the primary substation shall be by written order of the substation superintendent in charge. No verbal switching orders will be issued or accepted. Each written switching order shall be issued to and carried out only by high voltage journeymen. Each step in remote switching will be reported to and coordinated with the substation operator by telephone or radio, including arrival at and departure from each remote switching location.

1.4.1.3.1 Switching orders. Switching orders may be issued at the discretion of the assistant superintendent, Electrical Utilities or his designated representative for protection and safety of equipment and personnel, for preserving continuity of service, or for restoring service after an outage due to faulty cable, equipment or lighting failure, or other emergencies. Such operations shall be reported and explained in writing to the Chief, Electrical Utilities, NASA, within 24 hours.

1.4.1.3.2 Outage Requests. Persons or organizations requiring power interruptions or switching operations other than the preceeding shall submit KSC form 26-67 NS, High Tension Order, at least three working days prior to the planned operation. Approval from the assistant superintendent, Electrical Utilities and concurrence from the Electrical Utilities Chief, NASA, must be obtained before the request becomes valid. Upon completion of the operation, the order shall be marked with the date and time of departure, operation and return, and any additional information obtained during execution of the order. Such completed orders shall be kept on file at the substation by the assistant superintendent, Electrical Utilities.

1.4.1.4 Maintenance. Maintenance of system equipment and structures will be accomplished in accordance with Preventive Maintenance Instructions (PMI) issued by the Work Control Section.

1.4.1.4.1 Switching Orders. Switching orders to accomplish scheduled preventive maintenance shall be requested as noted in paragraph 1.4.1.2.

1.4.1.4.2 Planning. Whenever practical, the switching shall be planned to allow continued service during the performance of maintenance. The request shall include switching required to restore normal service.

1.4.2 MAINTENANCE AND OPERATION OF ELECTRICAL EQUIPMENT (VOLTAGES HIGHER THAN 480) AT LC-39.

1.4.2.1 Responsibility. LSOD is responsible for power distribution on the "line" side of any BOD/LSOD high voltage interface. BOD is responsible for power distribution on the "load" side of any BOD/LSOD high voltage interface.

1.4.2.2 Interface Determination. LSOD retains full responsibility for all maintenance and operation except for specific BOD responsibility defined herein. Fringe areas shall be LSOD responsibility, until document revisions state otherwise.

1.4.2.3 Operational access. BOD shall have operational access to and operational responsibility for switchgear and devices which are part of the control system for BOD assigned load devices, as well as for all components of the connected load. This includes operation of circuit breakers when the circuit breaker is part of the control or isolation system or when it serves a protective device. BOD may operate any unitized device which controls the branch power circuit to a BOD assigned load.

1.4.2.4 Maintenance Access and Responsibility. The user, or BOD, shall have maintenance access to and responsibility for BOD assigned load devices, load controllers and/or control stations except where controllers and/or control stations are within the enclosure of a motor control center or other unitized distribution center. BOD shall have maintenance access to and responsibility for control and power cables serving the connected load and the controller except where such cables originate at a unitized distribution center.

1.4.2.5 Test and Troubleshooting. BOD shall request of LSOD Contractors' Power Section access to motor control centers and/or other unitized distribution centers for testing or troubleshooting.

1.4.2.6 Additions and Modifications. The user shall initiate requests for any additions or modifications on Base Support Services Work Order Authorization, KSC Form 26-1 in accordance with current NASA instructions. Additions or modifications shall be accomplished by LSOD Contractors' Power Section upon issuance of the approved work order.

1.4.2.7 Trouble Calls. All high voltage trouble calls shall be reported to LSOD Contractors' primary substation operator. Trouble calls on the high voltage system are LSOD responsibility as per item 36 of BOD-LSOD agreement dated 10/30/64.